SPACECRAFT COMMUNICATIONS TERMINAL BREADBOARD COMPONENTS

FINAL REPORT

for the

NASA

MANNED SPACE FLIGHT CENTER

Houston, Texas

Contract ~~NAS8-12984~~ NAS9-12984

ADVANCED DEVELOPMENT

DEFENSE COMMUNICATIONS
492 River Road, Nutley, New Jersey 07110

February 1973

SPACECRAFT COMMUNICATIONS TERMINAL

BREADBOARD COMPONENTS

FINAL REPORT

for the

NASA

MANNED SPACE FLIGHT CENTER

Houston, Texas

Contract ~~NAS8-12984~~
NAS 9-12984

ADVANCED DEVELOPMENT

DEFENSE COMMUNICATIONS
492 River Road, Nutley, New Jersey 07110

February 1973

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. INTRODUCTION

1.1 OBJECTIVE

This final report represents the results of the technical effort during the period from July, 1972 through January, 1973 under contract NAS9-12984 to produce spacecraft communication terminal breadboard components consistent with the specifications.

1.2 SUMMARY

Photos of the overall translator chassis are shown in figures 1-1, 2 and 3 (front, top, three-quarter view). A block diagram of the complete assembly is shown in figure 1-4.

The following table summarizes the performance of the spacecraft communication terminal breadboard components:

Specification	NASA MSC Requirement	ITTDCD Performance
Packaging	Single unit capable of being rack mounted in a 19" rack.	Single unit capable of being rack mounted in a 19" rack.
Size		
Weight		26 lbs.
Power Consumption		115/120 VAC, 50-60 watts
Environment	Normal laboratory	Normal laboratory
	C-Band Translator/Transmitter/Attenuator	
IF Input Frequency	70 MHz	70 MHz
IF Bandwidth	100 MHz	100 MHz
IF Input Impedance	50 ohms	50 ohms
IF Input VSWR		1.5:1 max.

Input Signal Level	0 to +10 dBm	0 to +10 dBm
RF Output Frequency	6 GHz	6 GHz
RF Output Bandwidth	100 MHz	100 MHz
RF Output Level	Adjustable -110 to -70 dBm	Adjustable -110 to -70 dBm
Attenuator Accuracy	Repeatability error of 0. 5 dB under calibrated conditions	Repeatability error of 0. 5 dB under calibrated conditions
Carrier level stability		±0. 25 dB/day
RF Output Impedance	50 ohms	50 ohms
RF Output VSWR		1. 5: max.
Frequency Stability	±. 0015%	±. 0015%
Spurious Outputs	-138 dBm in a 4 kHz band at the attenuator output.	-138 dBm in a 4 kHz band at the attenuator output.

C-Band Translator/Receiver/Attenuator

RF Input Frequency	4 GHz	4 GHz
RF Input Bandwidth	100 MHz	100 MHz
RF Input Impedance	50 ohms	50 ohms
RF Input VSWR	1. 5:1	1. 5:1
RF Input Level	+20 to +40 dBm	+20 to +40 dBm
IF Output Frequency	70 MHz	70 MHz
IF Output Bandwidth	100 MHz	100 MHz
IF Output Impedance	50 ohms	50 ohms
IF Output VSWR		1. 5:1 max.
IF Output Level	Adjustable -75 dBm to -25 dBm	Adjustable -75 dBm to -25 dBm
Receiver Noise Figure	8 dB	8. 3 dB
Carrier Level Stability		±0. 25 dB/day
Attenuator Accuracy	Repeatability error 0. 5 dB under calibrated conditions.	Repeatability error of 0. 5 dB under calibrated conditions.

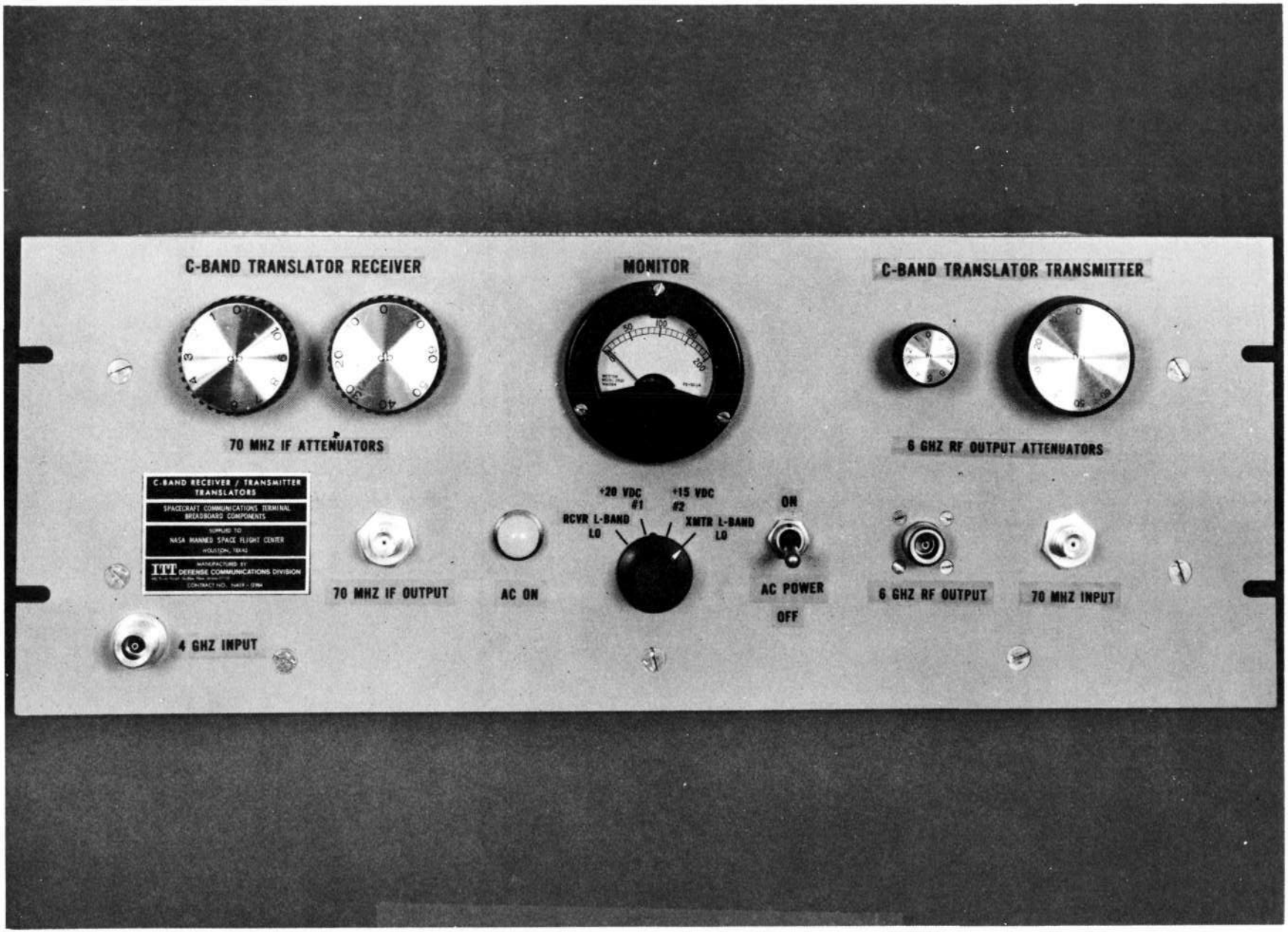


Figure 1-1 Translator Chassis, Front View (70705)

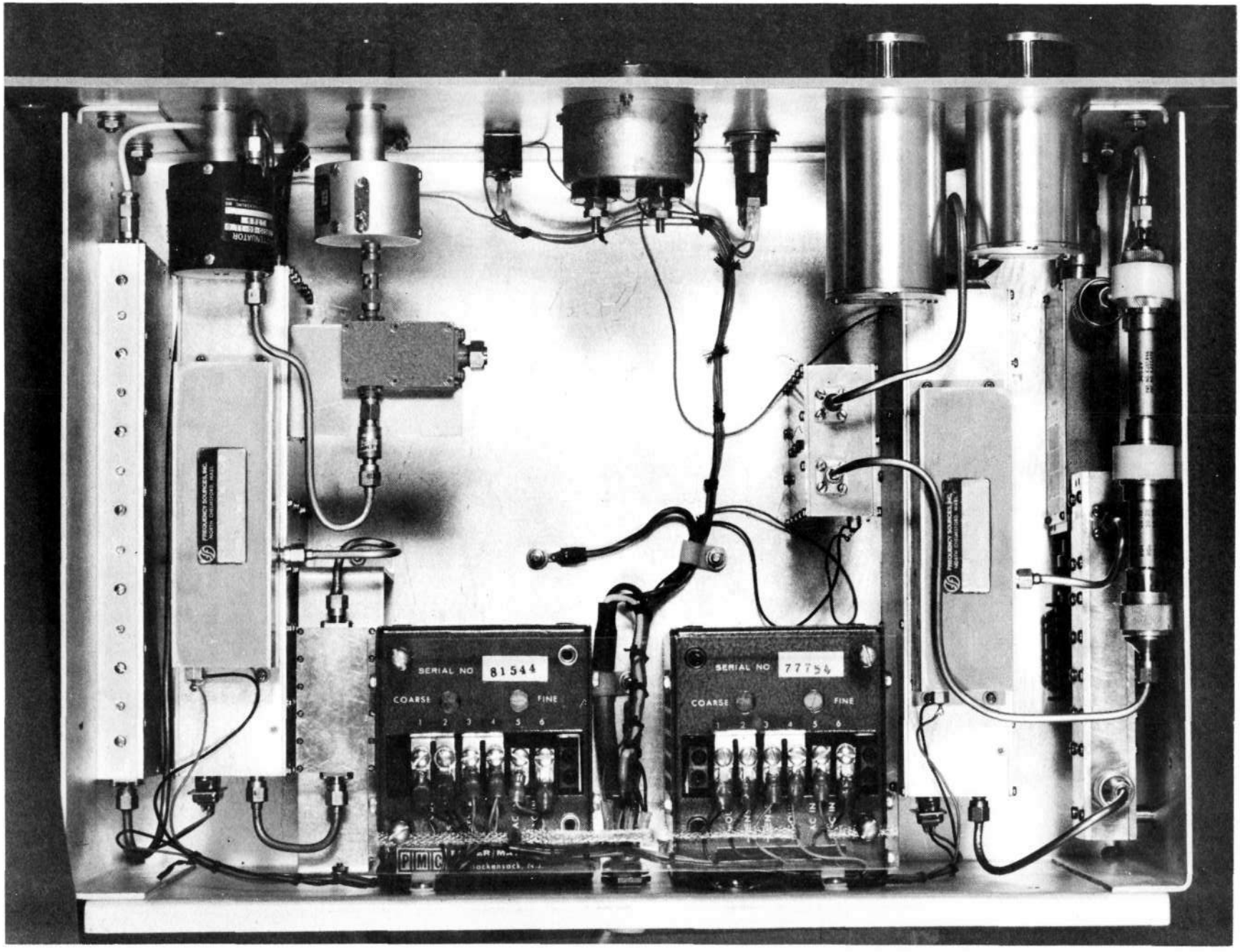


Figure 1-2 Translator Chassis, Top View (70704)

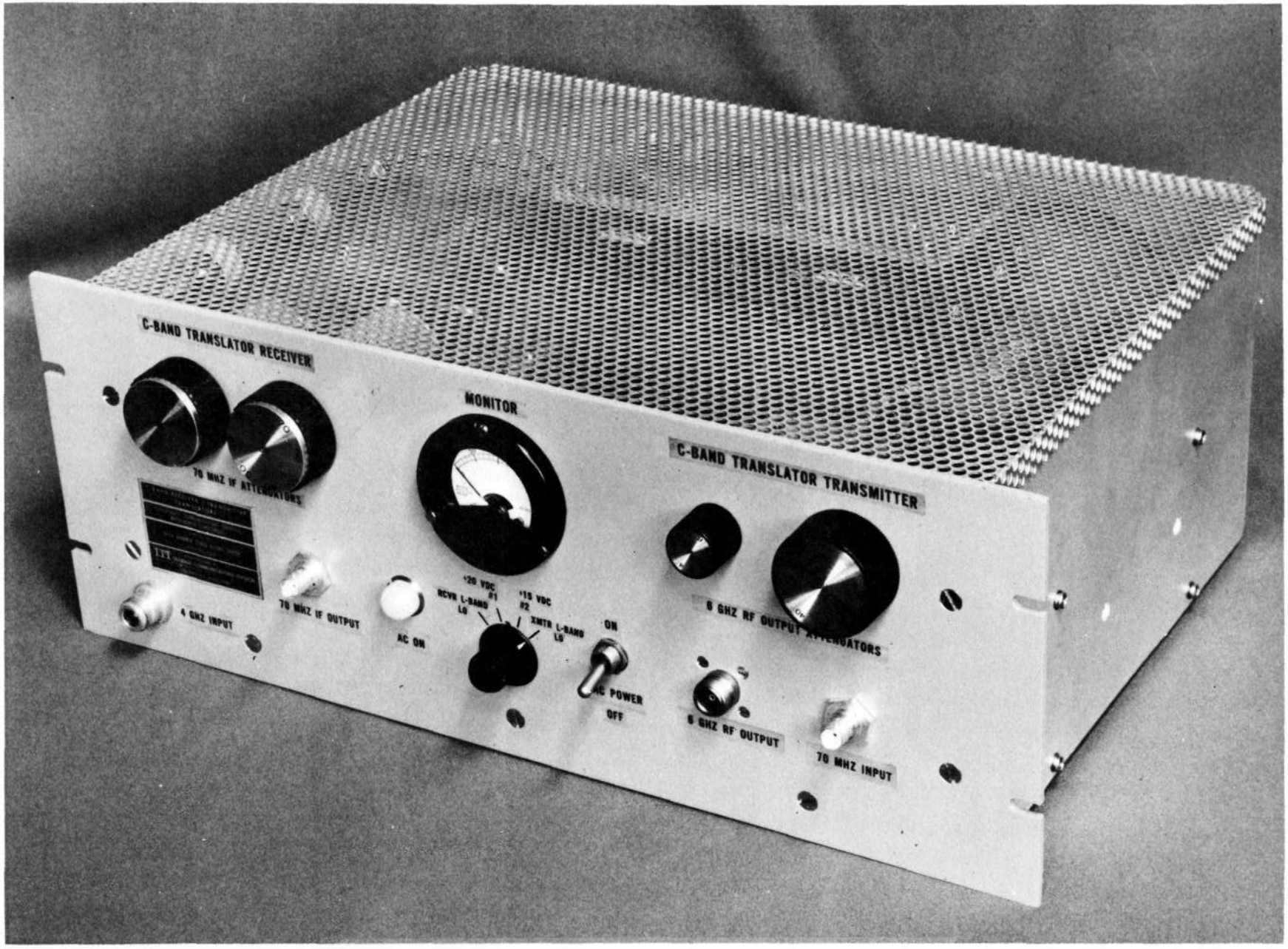


Figure 1-3 Translator Chassis, Three Quarter View (70706

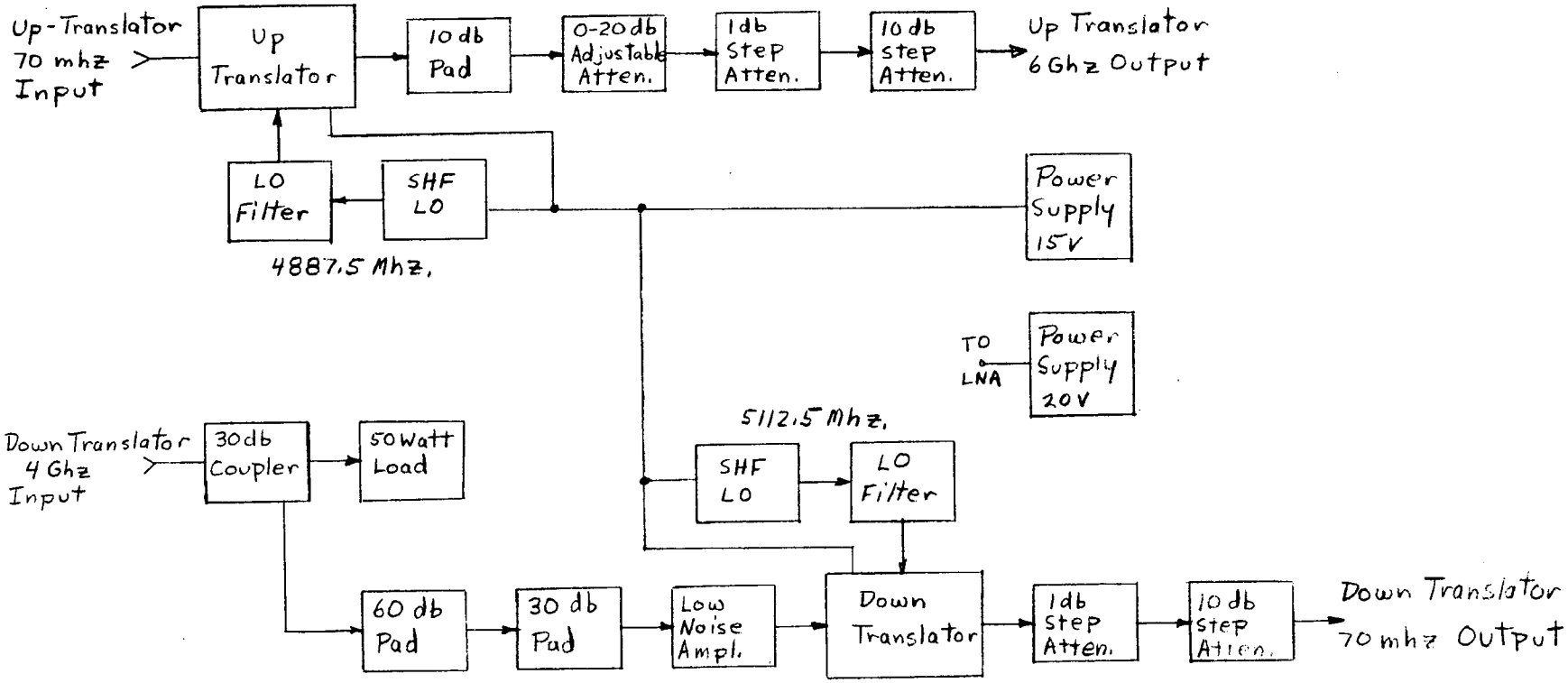


Figure 1-4 Translator Block Diagram

2. C-BAND TRANSLATOR/TRANSMITTER/ATTENUATOR

2.1 BLOCK DIAGRAM ASSEMBLY

The block diagram for the translator/transmitter is shown in figure 2-1. The only changes from the block diagram in the first quarterly report are the internal levels.

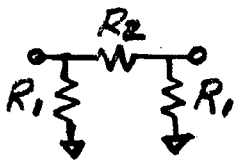
A photo of the up-converter is shown in figure 2-2 and a chassis drawing in figure 2-3.

2.2 COMPONENTS

2.2.1 INPUT ATTENUATOR

The input Attenuator design is complete. It consists of three 1/4 watt fixed composition resistors in a pi configuration. The specification for the Input Attenuator appears below with a schematic.

Frequency	20 to 120 MHz
Attenuation	20 dB nominal
VSWR	1.3:1 max.



$R_1 = 62$

$R_2 = 220$

1/4 W. Fixed Composition

Schematic

2.2.2 FIRST MIXER

The first mixer is a purchased, Summit Engineering, Boozeman, Montana, Model 761 unit. The measured performance of this mixer is shown in the table below along with the specification.

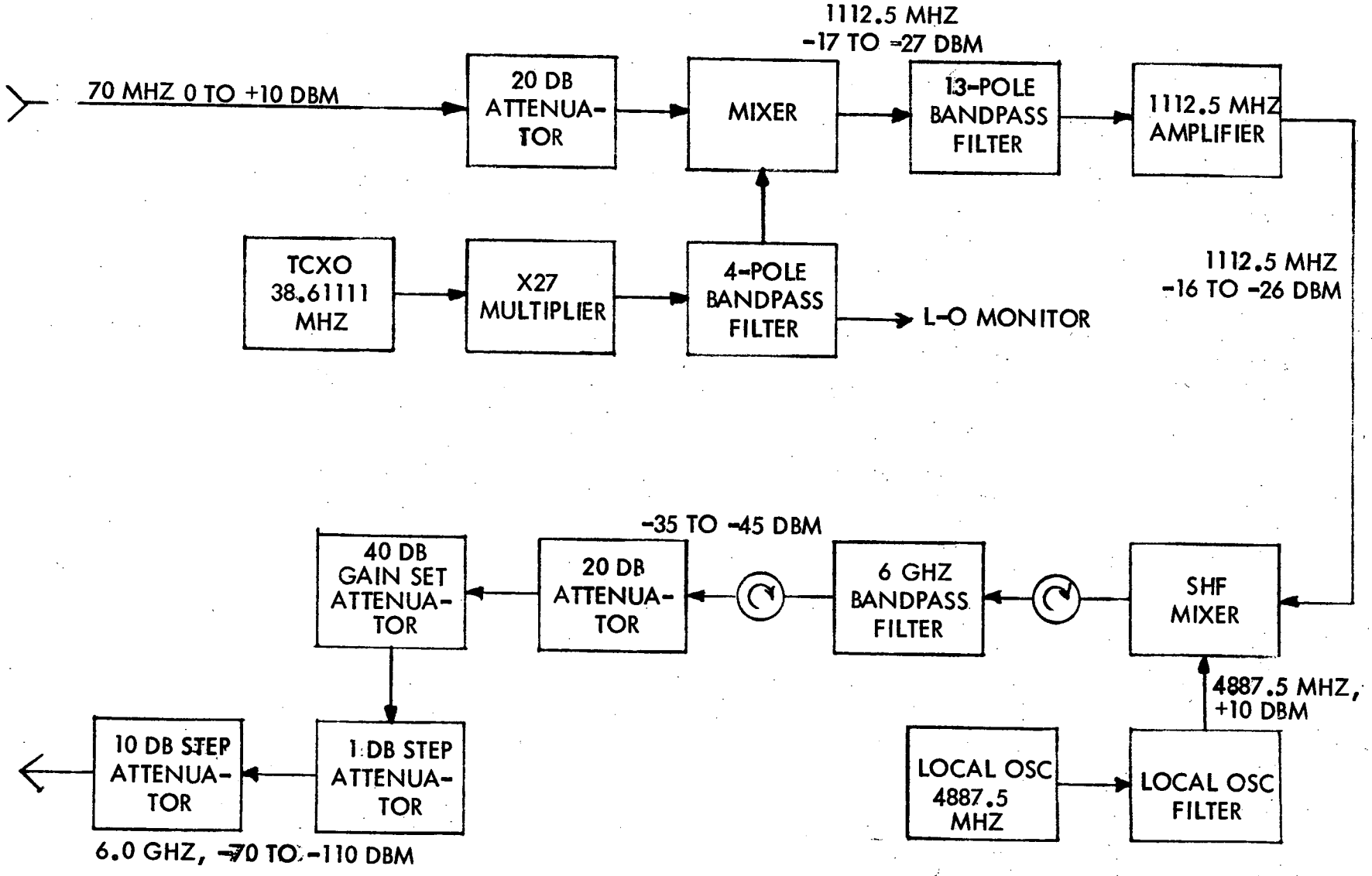


Figure 2-1 Translator Upconverter, Block Diagram

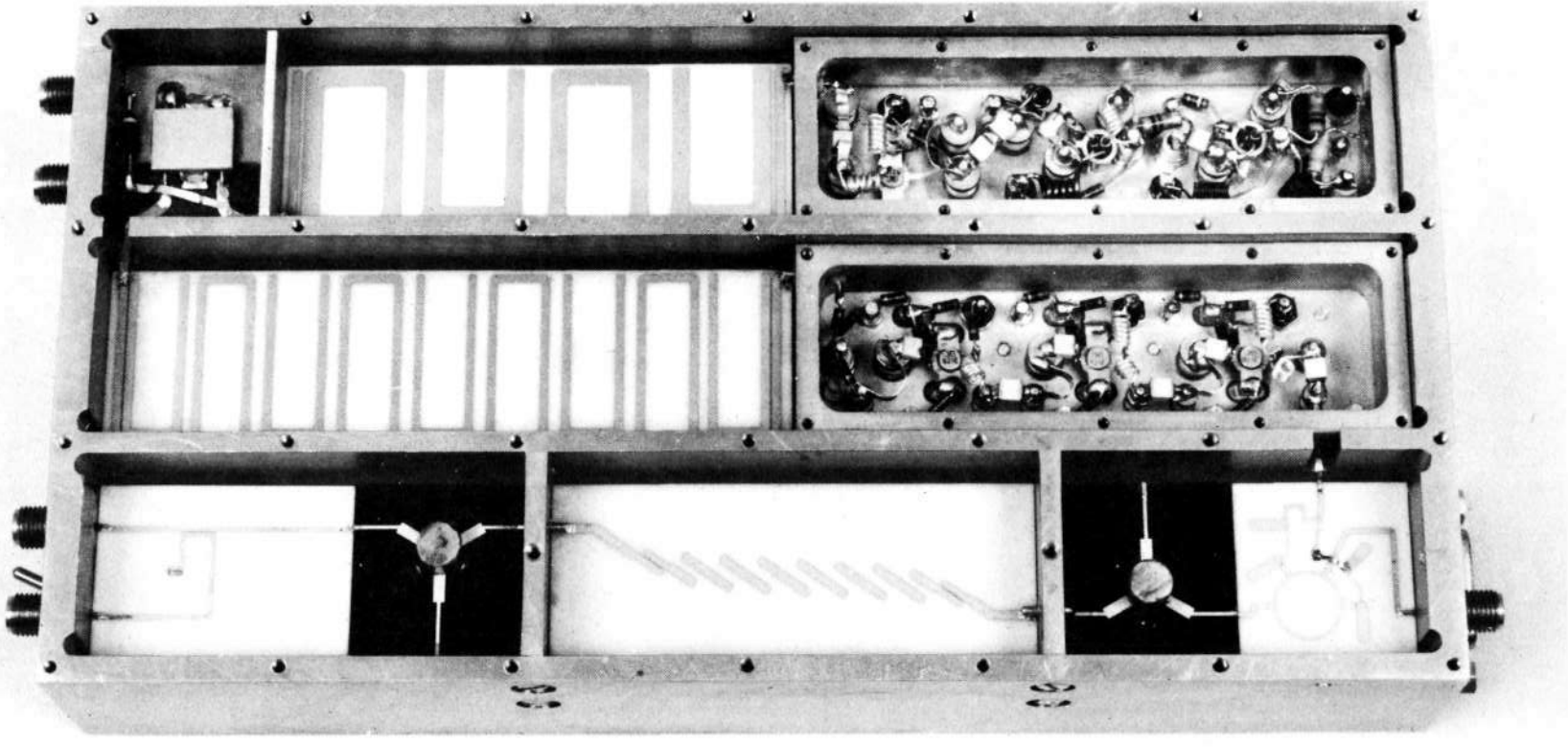
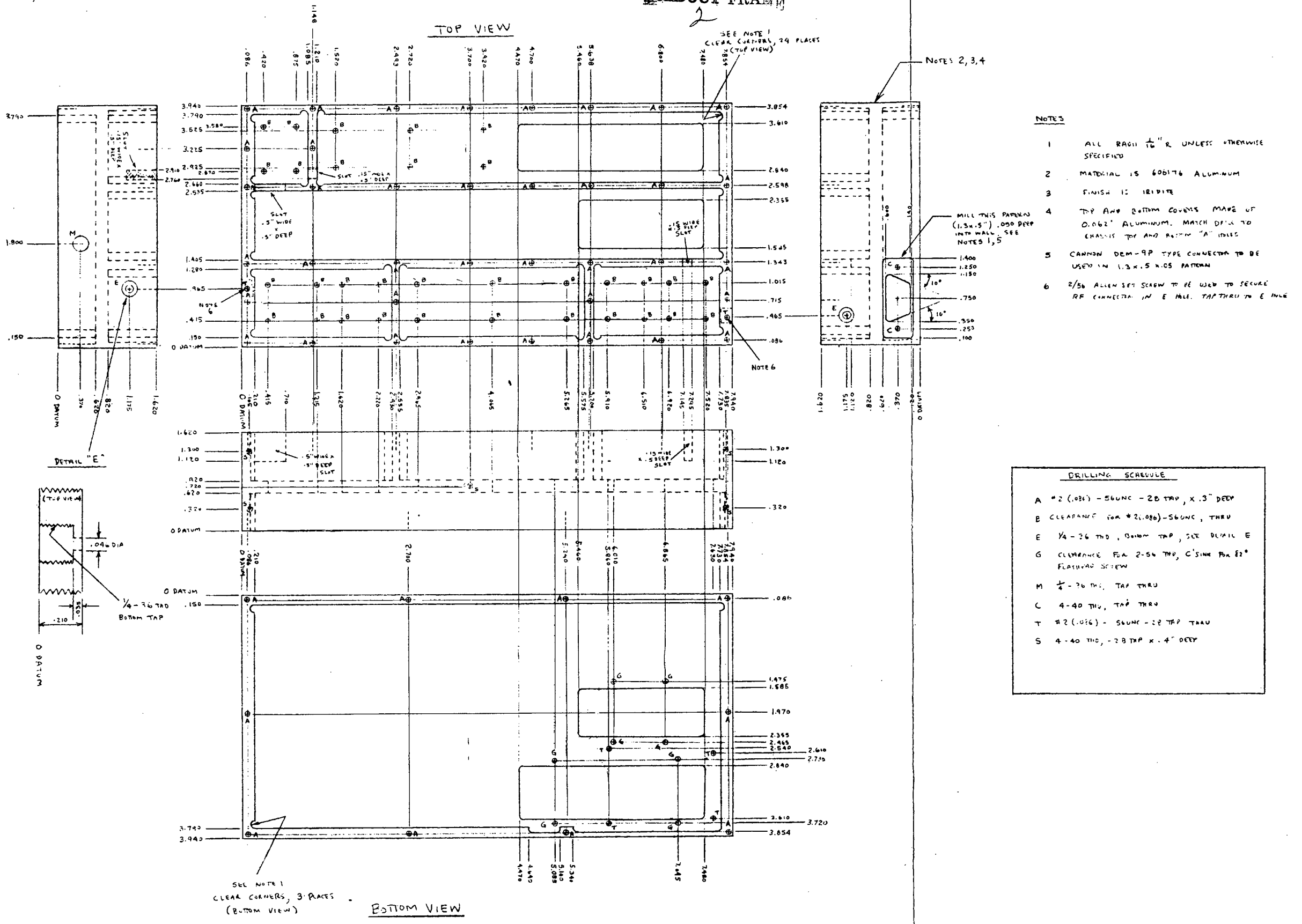


Figure 2-2 Translator Upconverter (68606)

FOLDOUT FRAME 1

FOLDOUT FRAME 2



NOTES

1. ALL RADII ±.16" R UNLESS OTHERWISE SPECIFIED
2. MATERIAL IS 6061T6 ALUMINUM
3. FINISH IS IRIDITE
4. TOP AND BOTTOM COVERS MADE OF 0.062" ALUMINUM. MATCH DRILL TO CHASSIS TOP AND BOTTOM "A" HOLES
5. CANNON DEM-9P TYPE CONNECTOR TO BE USED IN 1.3 x .5 x .05 PATTERN
6. 2/56 ALLEN SET SCREW TO BE USED TO SECURE RF CONNECTOR IN E HOLE. TAP THRU TO E HOLE

DRILLING SCHEDULE

A	#2 (.086) - 56UNC - 2B TAP, X .3" DEEP
B	CLEARANCE FOR #2(.086) - 56UNC, THRU
E	1/4 - 36 THD, BOTTOM TAP, SEE DETAIL E
G	CLEARANCE FOR 2-56 THD, C'SINK FOR 82° FLATHEAD SCREW
M	1/4 - 36 THD, TAP THRU
C	4-40 THD, TAP THRU
T	#2 (.086) - 56UNC - 2B TAP THRU
S	4-40 THD, - 2B TAP X .4" DEEP

Figure 2-3 Translator Upconverter Chassis Drawing

	Specification	Performance
RF Output Frequency	1112. 5 MHz	1112. 5 MHz
LO Frequency	1042. 5 MHz	1042. 5 MHz
IF Input Frequency	70 MHz	70 MHz
RF Bandwidth	100 MHz	100 MHz
LO/RF Isolation	50 dB	50 dB
LO Level	+7 to +10 dBm	+7 to +10 dBm
Conversion Loss	8 dB	8 dB

2. 2. 3 1042. 5 MHZ LO

The TCXO for this LO chain is a CTS Knight Model 9703232. A schematic of the X27 multiplier is shown in figure 2-4. A curve showing the performance of the 1042. 5 MHz Lo output filter is shown in figure 2-5 and a photo in figure 2-6.

The performance specifications for the LO are tabulated below for reference.

Output Frequency	1042. 5 MHz
Frequency Stability	±. 0001%
Output Level	+10 dBm
Spurious Outputs	85 dB below nominal Output

2. 2. 4 1112. 5 MHZ IF FILTER

A 13 pole interdigital band pass filter has been fabricated. A photo of this filter appears in figure 2-7. The frequency response of this filter is shown in figure 2-8.

A summary of performance appears below:

	Specification	Performance
Frequency	1112. 5 MHz	1112. 5 MHz
Bandwidth	100 MHz	100 MHz
Rejection	55 dB at 1042. 5 MHz	55 dB
Design	13 Pole	13 Pole
	. 1 dB Tchebyshev	. 1 dB Tchebyshev
Loss	1 dB	1. 2 dB
Band Edge Droop	1 dB	0. 5 dB

FOLDOUT FRAME 1

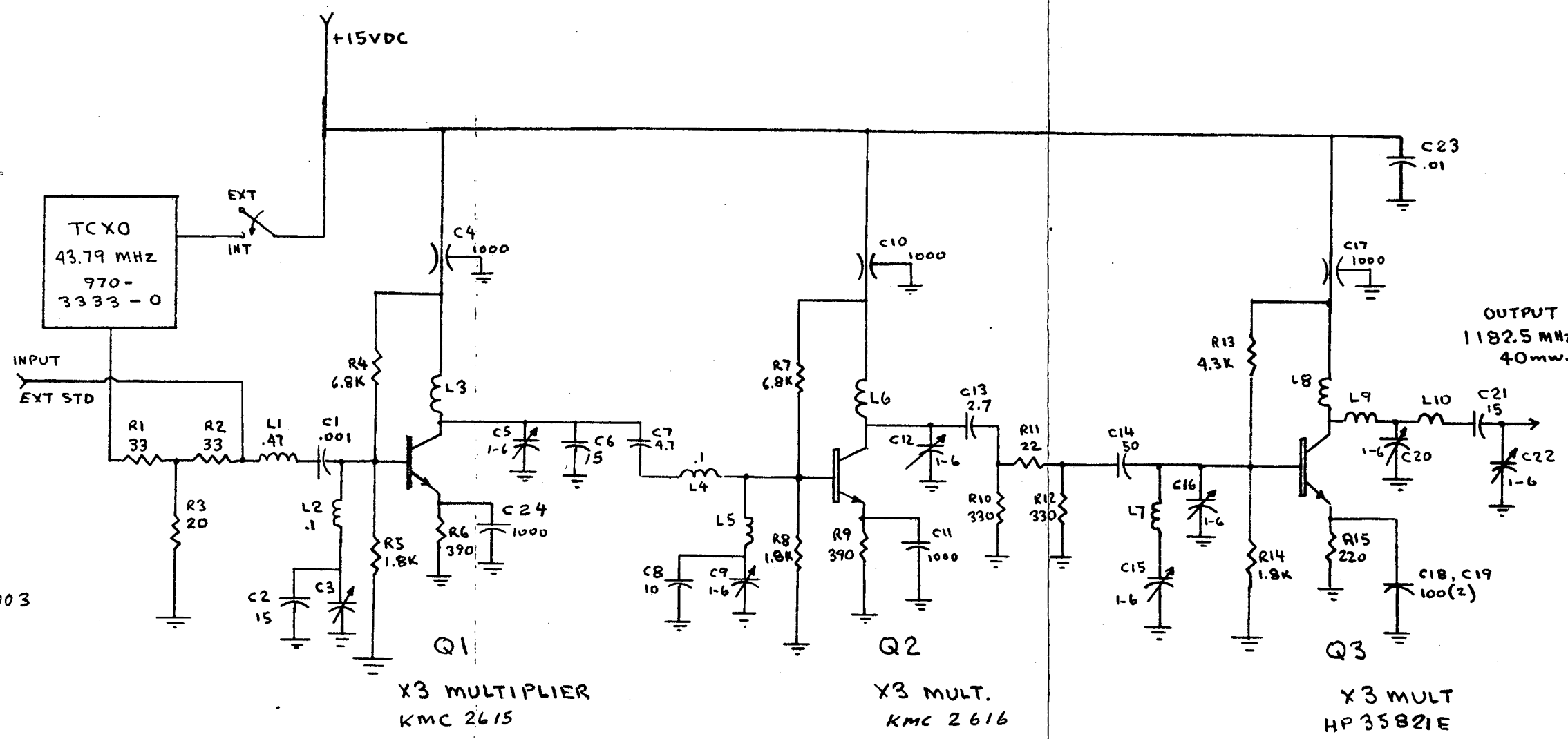
PARTS LIST

R1 Resistor, Carbon, 33 ohm, 1/8 WATT, ± 5%
R2 Resistor, Carbon 20 ohm, 1/8 WATT. ± 5%
R3 Resistor, Carbon, same as R1
R4 Resistor, Carbon, 6.8 Kohm, 1/8 WATT. ± 5%
R5 Resistor, Carbon, 1.8 Kohm, 1/8 WATT. ± 5%
R6 Resistor, Carbon, 390 ohm, 1/8 WATT, ± 5%
R7 Resistor, Carbon, same as R4.
R8 Resistor, Carbon, same as R5.
R9 Resistor, Carbon same as R6
R10 Resistor, Carbon. 330 ohm, 1/8 WATT ± 5%
R11 Resistor, Carbon. 22 ohm, 1/8 WATT ± 5%
R12 Resistor. Carbon, same as R10.
R13 Resistor Carbon, 4.3 Kohm, 1/8 WATT, ± 5%
R14 Resistor. Carbon, same as R5
R15 Resistor, Carbon, 220 ohm, 1/8 WATT, ± 5%

Q1 Transistor. NPN. Kmc 2115
Q2 Transistor, NPN KMC 2116
Q3 Transistor, NPN, MICROWAVE, HP 35821E

C1 Capacitor, 1000 pf ± 20%. CK05CW102M
C2 Capacitor, 15 pf, ATC 100-B-15-K-MS
C3 Capacitor, Variable .4-6 pf, Johanson 5702
C4 Capacitor, Feed Thru, 1000 pf, Erie 2425-003
C5 Capacitor, same as C3.
C6 Capacitor, same as C2.
C7 Capacitor, 4.7 pf. ATC 100-B-4R7-K-MS
C8 Capacitor, 10 pf. ATC 100-B-10-K-MS
C9 Capacitor, same as C3.
C10 Capacitor, same as C4.
C11 Capacitor, 1000 pf, ATC 100-B-1000-N-MS
C12 Capacitor, same as C3
C13 Capacitor, 2.7 pf, ATC 100-B-2R7-D-MS
C14 Capacitor. 50 pf, ATC 100-B-50-K-MS
C15 Capacitor, same as C3
C16 Capacitor. same as C3
C17 Capacitor, same as C4
C18 Capacitor, 100 pf, ATC 100-B-100-K-MS
C19 Capacitor, Same as C18
C20 Capacitor. same as C3
C21 Capacitor. same as C2
C22 Capacitor, same as C3
C23 Capacitor. .01 pf, CKR06CW103K
C24 Capacitor, same as C11

FOLDOUT FRAME 2



L1 Inductor, Fixed, .47 uh ±10% Delevan 1025-12
L2 Inductor, Fixed. .1 uh NYTRONICS DD-0.10 ±10%
L3 Inductor, 8.5 Turns #22 Wire 1/8 ID equally Spaced
L4 Inductor, same as L2.
L5 Inductor, 4.5 Turs # 22 Bus Wire 1/16 ID equally spaced
L6 Inductor 4.5 Turns # 20 Wire 3/32 ID " "
L7 Inductor. strip 0.8" Long; 0.1" WIDE, .005" THK
L8 Inductor, 7 Turns # 22 Bus Wire 1/16 ID equally spaced
L9 Inductor, 5 Turns # 22 " " " "
L10 Inductor. strip 0.8 LONG Part of chip capacitor

TXCO: TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR Freq: 43.796296 MHz
+10 to +135°C, 0.2 ppm/day MODEL 970-3333-0 CTS KNIGHT, INC.

X27 AMPLIFIER FREQUENCY MULTIPLIER
(1182.5 MHz)

(USED WITH)
DOWN CONVERTER

Figure 2-4 X27 Multiplier, Schematic Diagram

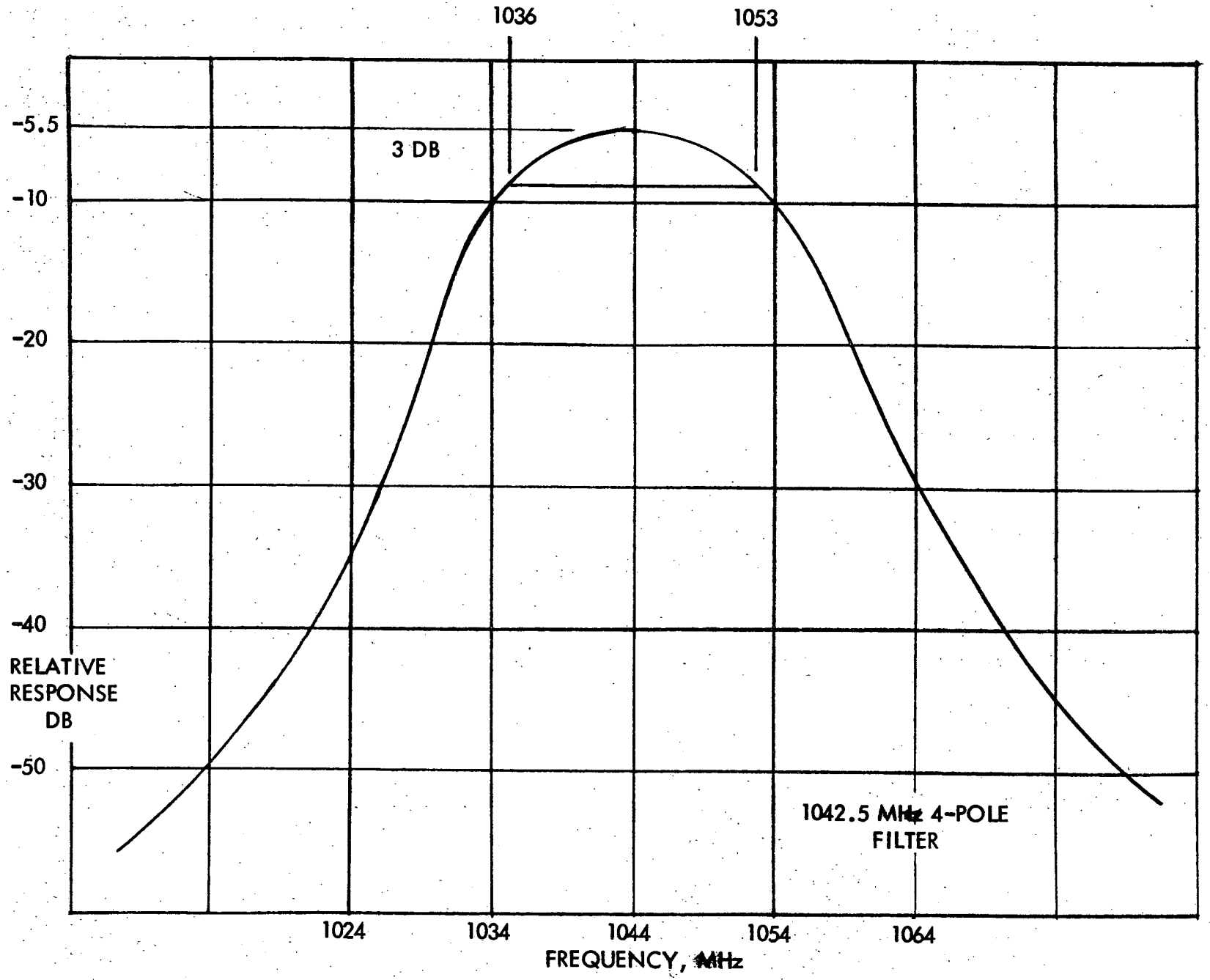


Figure 2-5 1042.5 MHz Filter Frequency Response

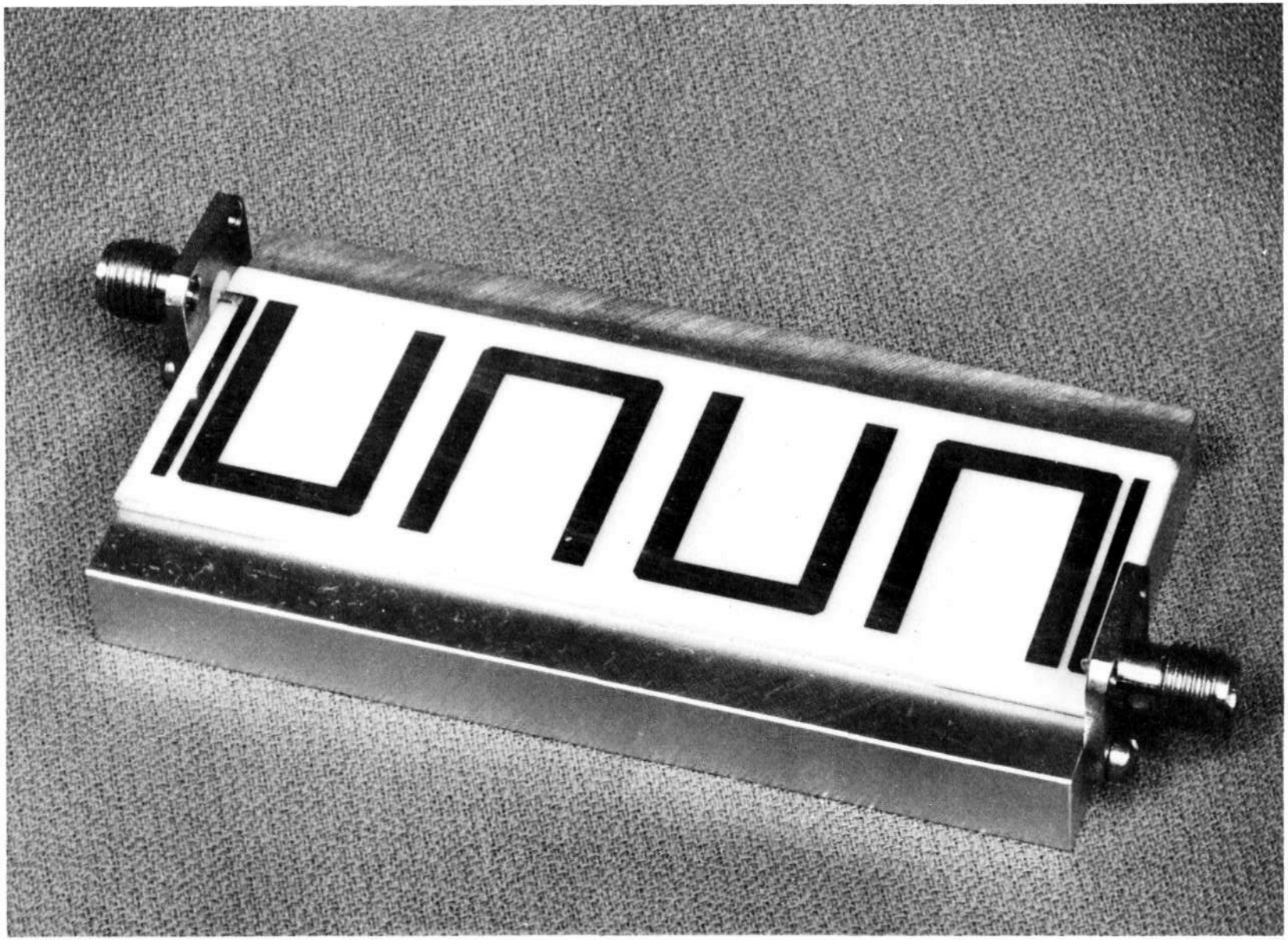


Figure 2-6 1042.5 MHz Output Filter (68477)

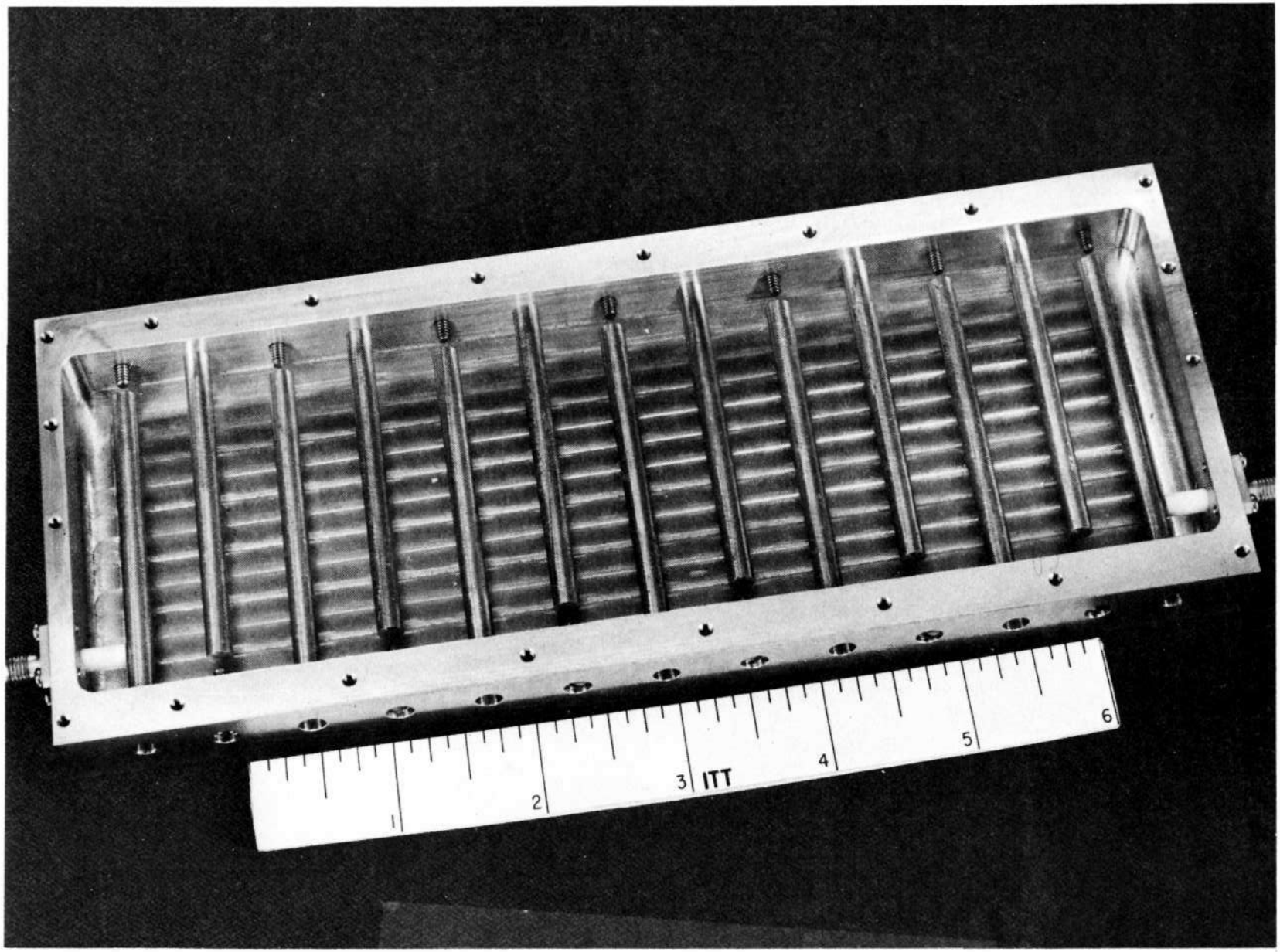


Figure 2-7 1112.5 I-F Bandpass Filter (70360)

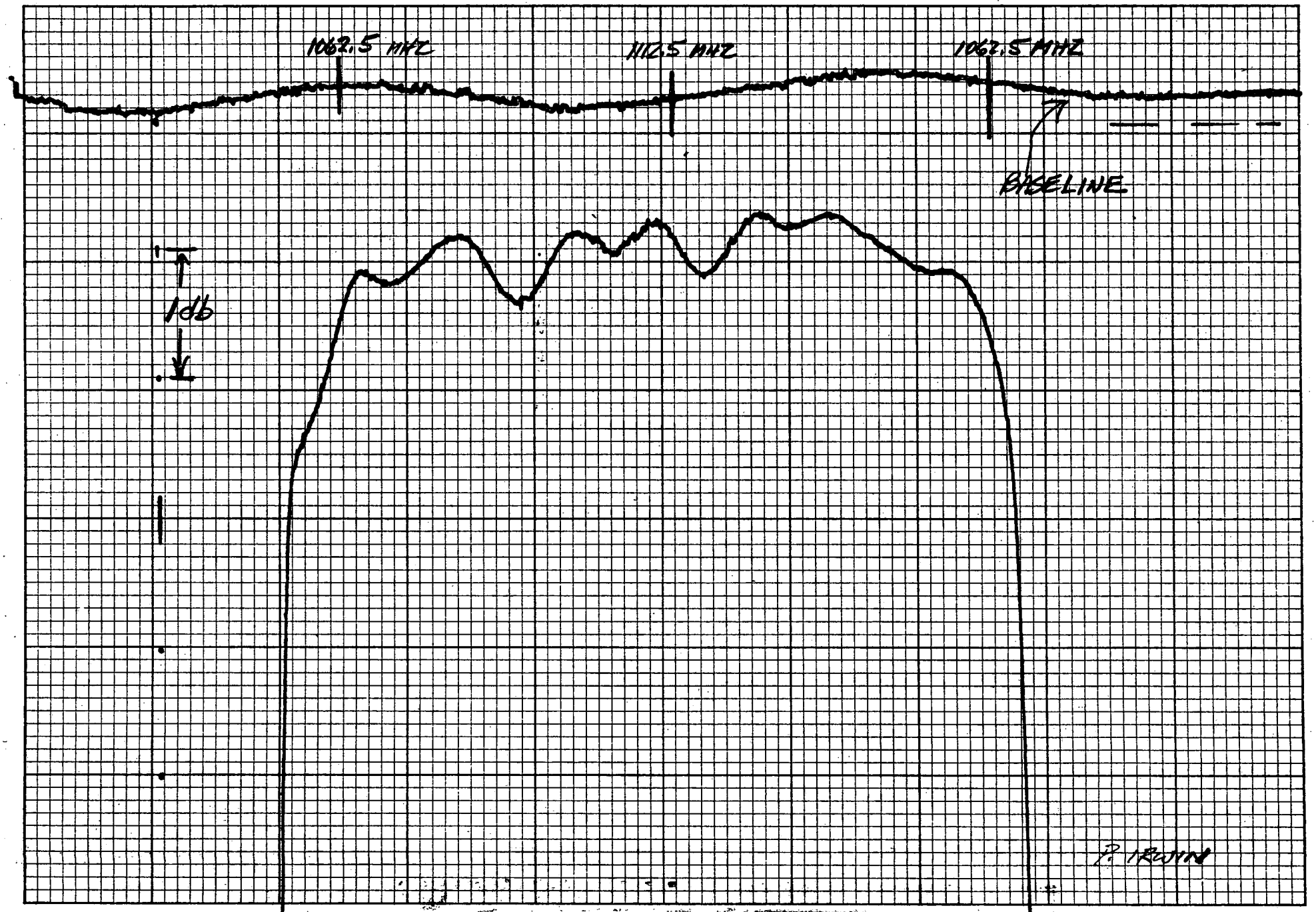


Figure 2-8 1112.5 I-F Bandpass Filter Response

2.2.5 1112.5 MHZ AMPLIFIER

The 1112.5 MHz amplifier has been fabricated. A schematic of the 1112.5 MHz amplifier is shown in figure 2-9. The measured amplifier performance appears below:

	Specification	Performance
Frequency	1112.5 MHz	1112.5 MHz
Bandwidth	100 MHz	100 MHz
Gain	15 dB	20 dB
Input VSWR	1.2:1 max.	1.5:1 max.
Output VSWR	1.5:1 max.	1.5:1 max.

A photo of this amplifier is shown in figure 2-10.

2.2.6 SHF MIXER

The SHF mixer is a microstrip balanced mixer. A photo of this mixer is shown in figure 2-11 and a performance summary appears below.

Input Frequency	1112.5 MHz	1112.5 MHz
Output Frequency	6.0 GHz	6.0 GHz
LO Frequency	4887.5 MHz	4887.5 MHz
LO Level	+10 to +13 dBm	+10 to +13 dBm
Conversion Loss	9 dB	9 dB
LO/RF Isolation	25 dB	25 dB

2.2.7 SHF LO

The SHF local oscillator is a Frequency Sources Model FS-30 purchased to the following specifications:

Output Frequency	4887.5 MHz
Output Power	+10 dBm
Output VSWR	1.5:1 max.
Frequency Stability	±.0015%
Spurious	65 dB below output level in ±2000 MHz band around f_o.

A copy of the manufacturers test data is shown in figure 2-12.

FOLDOUT FRAME
1

PARTS LIST

R1 Resistor, Carbon, 10 ohm, 1/8 WATT, ± 5%.
R2 Resistor, Carbon, 120 ohm, 1/8 WATT, ± 5%.
R3 Resistor, same as R1.
R4 Resistor. Carbon. 1000 ohm, 1/8 WATT, ± 5%.
R5 Resistor, Carbon, 1800 ohm, 1/8 WATT, ± 5%.
R6 Resistor, Carbon. 8.2K ohm, 1/8 WATT. ± 5%
R7 Resistor, Carbon. 750 ohm, 1/8 WATT, ± 5%
R8 Resistor, Carbon, 180 ohm. 1/8 WATT, ± 5%
R9 Resistor, same as R5
R10 Resistor, Carbon. 5.6K ohm, 1/8 WATT, ± 5%.
R11 Resistor, same as R4.
R12 Resistor, same as R8.
R13 Resistor, same as R5.
R14 Resistor, Carbon. 4.7K ohm, 1/8 WATT, ± 5%.
R15 Resistor, same as R4.
R16 Resistor, same as R8.
R17 Resistor, 91 ohm, 1/8 WATT ± 5%

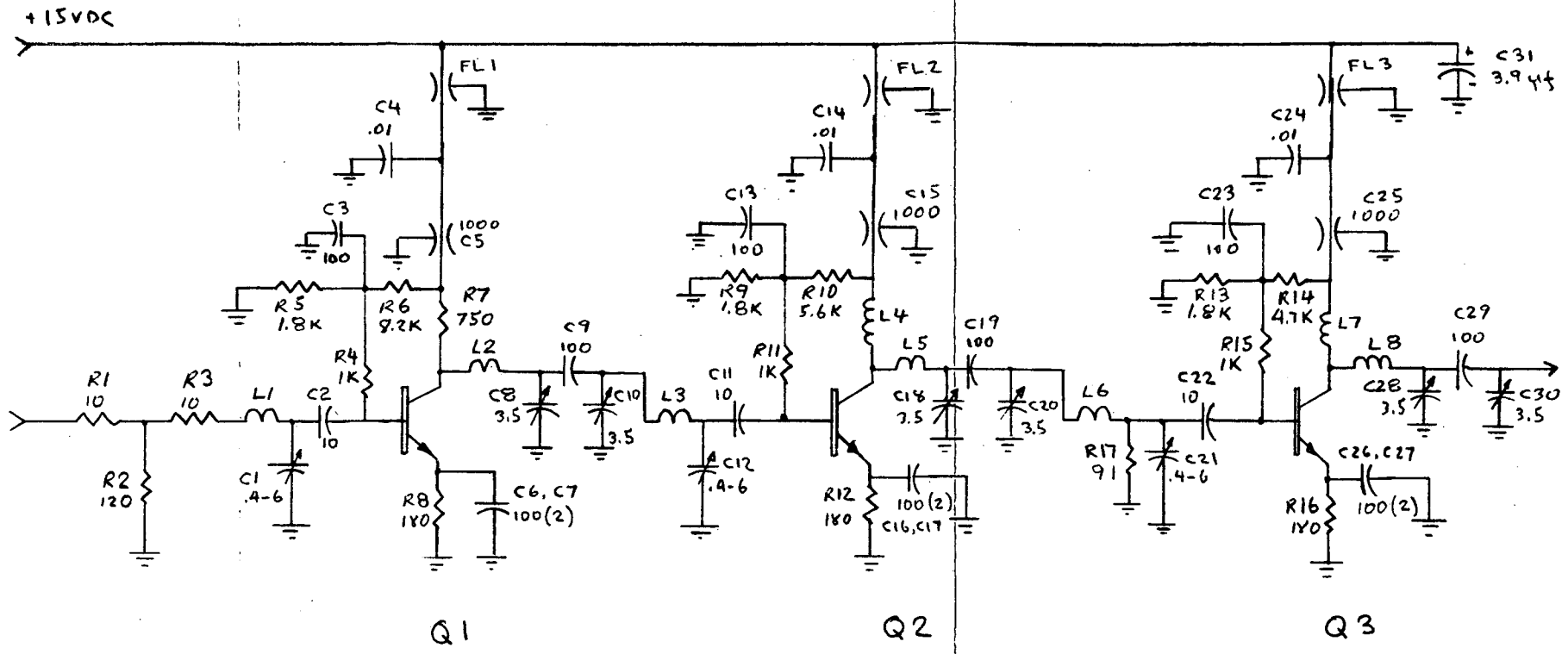
Q1 Transistor, NPN, HP35821E
Q2 Transistor, same as Q1
Q3 Transistor, same as Q1.

C1 Capacitor. Variable, .4-6pf Johanson 5702
C2 Capacitor, 10 pf, ATC100-B-10-K-MS
C3 Capacitor. 100pf, ATC100-B-100-K-MS
C4 Capacitor. Ceramic, .01 uf, CKR06CW103K
C5 Capacitor Feed Thru, 1000pf, Erie 2425-003
C6 Capacitor, same as C3.
C7 Capacitor, same as C3.
C8 Capacitor, Variable .4-3.5pf, Johanson 5802
C9 Capacitor, same as C3.
C10 Capacitor, same as C8.
C11 Capacitor, same as C2.
C12 Capacitor, same as C1.
C13 Capacitor, same as C3.
C14 Capacitor, same as C4
C15 Capacitor same as C5.
C16 Capacitor, same as C3.
C17 Capacitor, same as C3.
C18 Capacitor, same as C8
C19 Capacitor, same as C3.
C20 Capacitor, same as C8
C21 Capacitor, same as C1.
C22 Capacitor, same as C2.
C23 Capacitor same as C3.
C24 Capacitor, same as C4
C25 Capacitor, same as C5
C26 Capacitor, same as C3
C27 Capacitor, same as C3
C28 Capacitor, same as C8
C29 Capacitor, same as C3
C30 Capacitor, same as C8
C31, Capacitor, Fixed, 3.9uf, 35VDC KEMET CSR13H39KP

FL1 FILTER, LINE, FILTERCON, ERIE/270-009
FL2 FILTER, same as FL1.
FL3 FILTER, same as FL1.

L1 Inductor, strip, 0.5" LONG, .075 WIDE, GOLD PLATED .007" THICK
L2 Inductor, 2 TURNS #22 AWR SILVEL .070" ID, 1/8" LONG
L3 Inductor, strip 0.4" LONG, .075 WIDE, GOLDPLATED .007" THICK
L4 Inductor, 6 TURNS #22 AWR SILVER .070 ID, .4" LONG,
L5 Inductor, same as L2.
L6 Inductor, same as L3.
L7 Inductor, same as L4.
L8 Inductor, same as L2.

FOLDOUT FRAME
2



WIDE BAND
PRE-AMP FOR UPCONVERTER
Center Freq. = 1112.5 MHz
Nominal Gain = 40 dB

Figure 2-9 1112.5 MHz Amplifier, Schematic Diagram

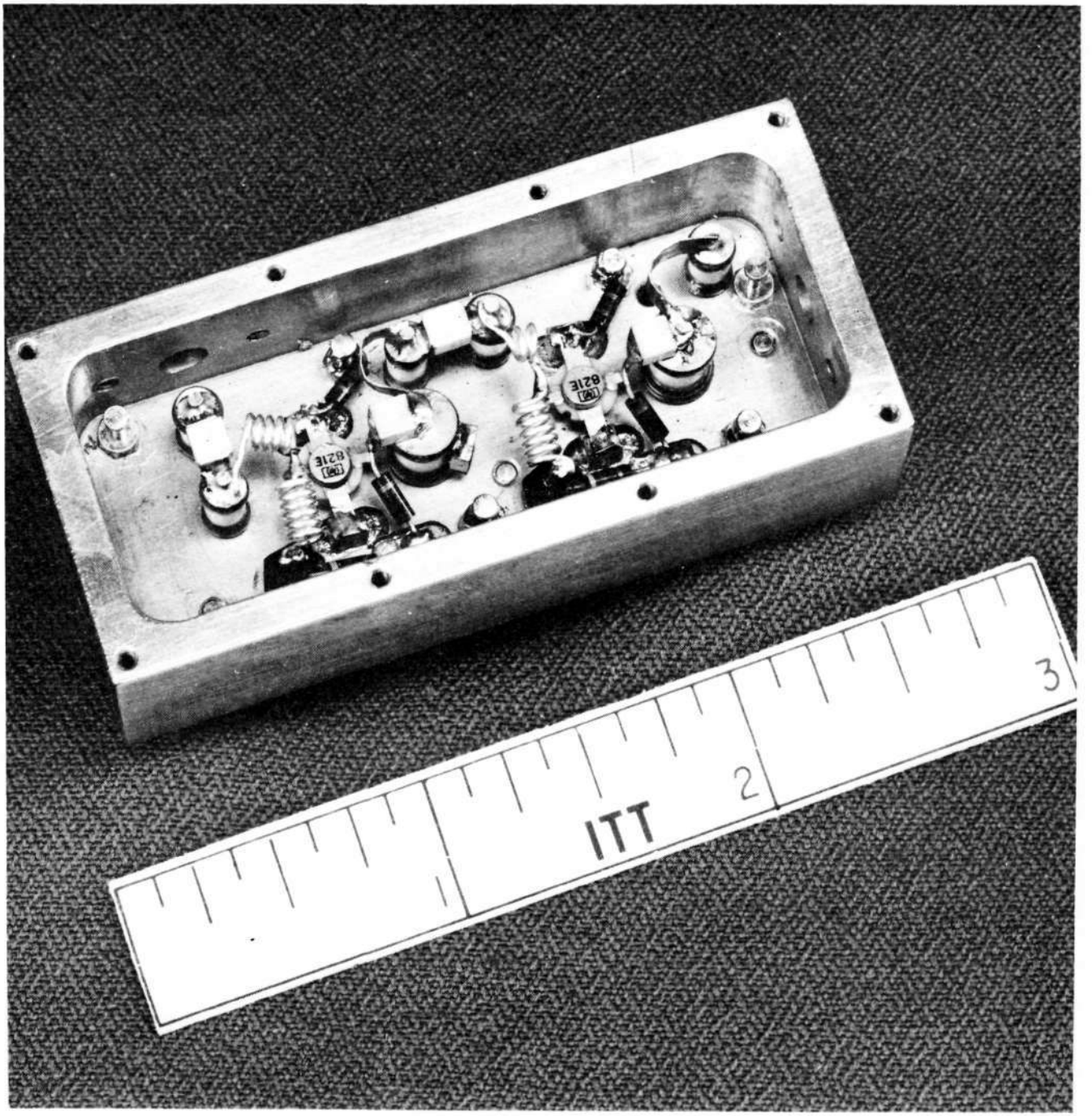


Figure 2-10 1112.5 MHz Amplifier (70362)

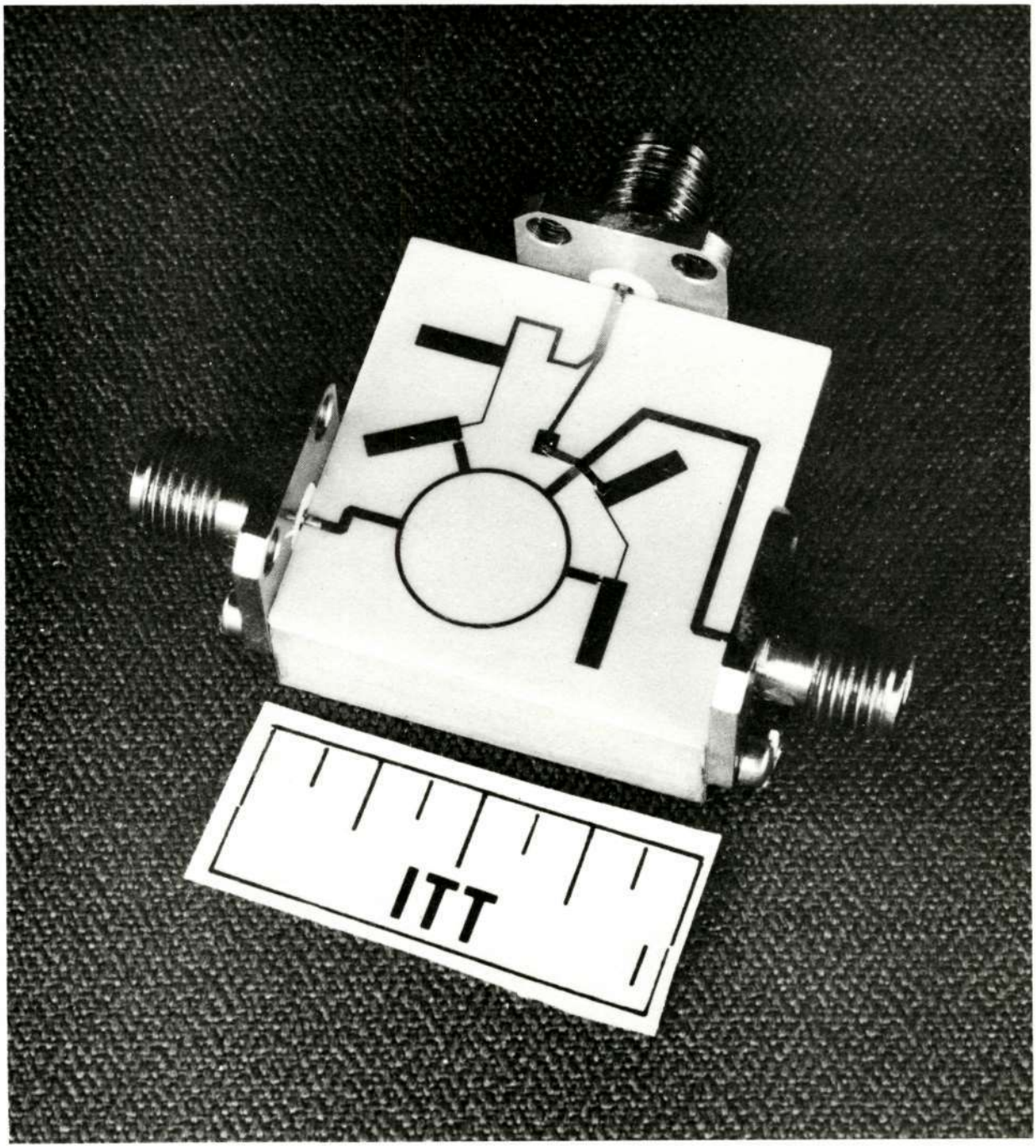


Figure 2-11 SHF Mixer (70361)

I.T.T.

P.O. NO. 580310

CUST. NO. 3266

FREQ. 4887.5 MHZ

T NO. FS-30

Frequency Sources Inc.
KENNEDY DRIVE • P.O. BOX 159
NORTH CHELMSFORD, MASS. 01863

SER. NO. 8002

DATE 10/5/72

TEST DATA SHEET

TEMPERATURE	FREQUENCY	POWER
0 °C	4887.5277 MHZ	28.0 Mw
+25 °C	4887.5010 MHZ	26.5 Mw
+60 °C	4887.3900 MHZ	21.0 Mw

Spurious Rejection: ✓ OK

2.1 Mismatch Check: ✓ OK

D.C. Power +15.0 VDC @ 115 Ma.

Fig 2-12

OPERATING VOLTAGE _____ AT _____ MA.

TECH: [signature]

Q.C.: [signature]

Figure 2-12 SHF Local Oscillator Manufacturer's Test Data Sheet

2.2.8 6 GHz ISOLATORS

The 6 GHz Isolators performance is tabulated below:

	Specification	Performance	
Frequency	6.0 GHz	6.0 GHz	6.0 GHz
Bandwidth	200 MHz	200 MHz	200 MHz
Isolation	20 dB min.	26 dB	27 dB
VSWR	1.2:1 max.	1.27:1	1.22:1
Loss	0.8 dB max.	.6 dB	.6 dB

2.2.9 6 GHZ BANDPASS FILTER

The 6 pole MIC 6 GHz bandpass filter is shown in the photo of figure 2-13. The performance is shown in the curve of figure 2-14 and a performance summary is tabulated below:

	Specification	Performance
Frequency	6.0 GHz	6.0 GHz
Bandwidth	200 MHz	600 MHz
Rejection	80 dB at 4887.5 MHz	80 dB
Design	6 pole, 0.1 dB Tchebyshev	6 pole, 0.1 dB Tchebyshev
Loss	2 dB	1.5 dB

This filter has a wider bandwidth than required. The performance of the translator is not affected by this as long as the Rejection specification is met.

2.2.10 FIXED ATTENUATOR

A Narda, Model 777C fixed attenuator was purchased and has been received to the following specifications:

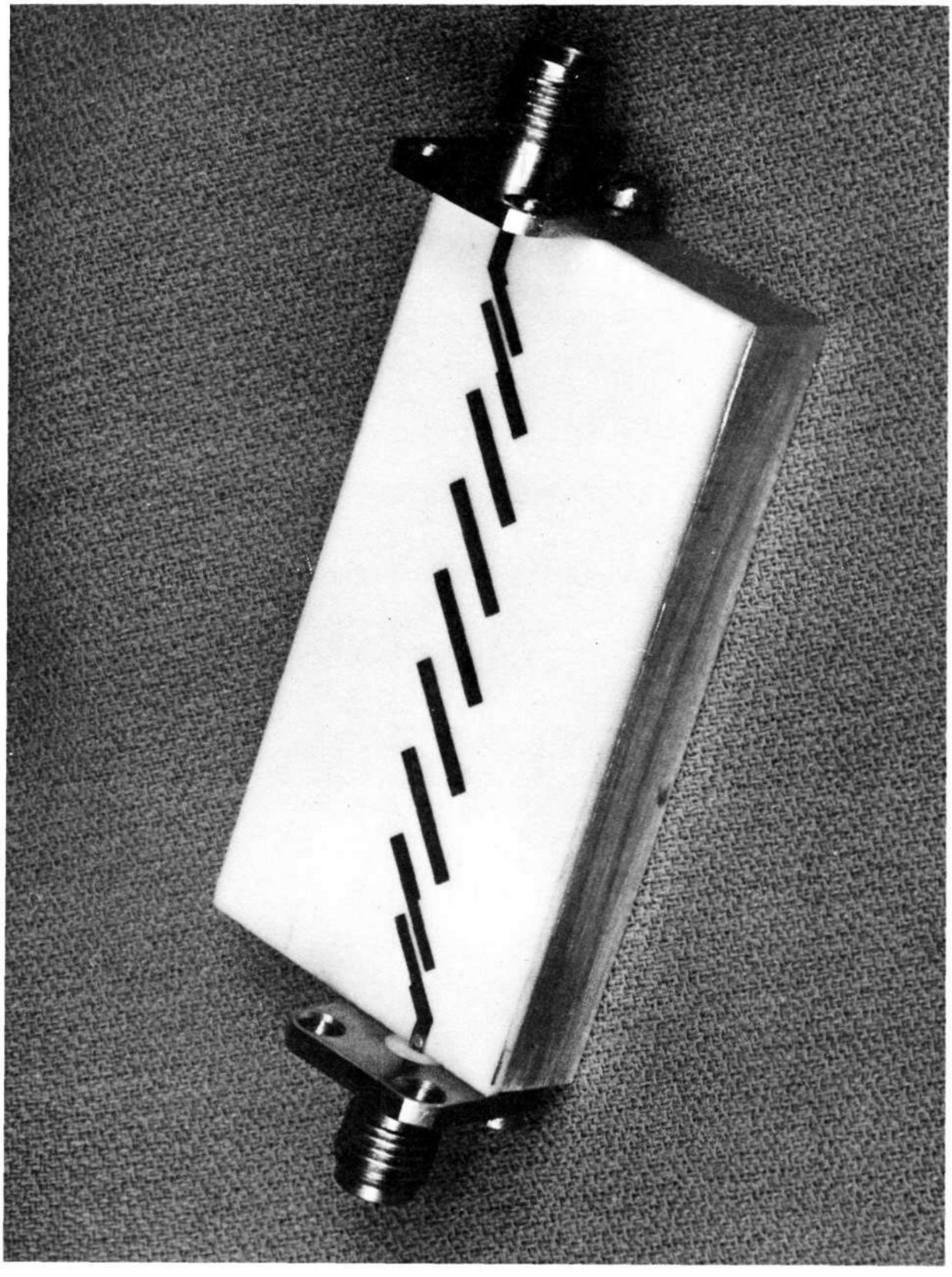


Figure 2-13 6 GHz Bandpass Filter (68479)

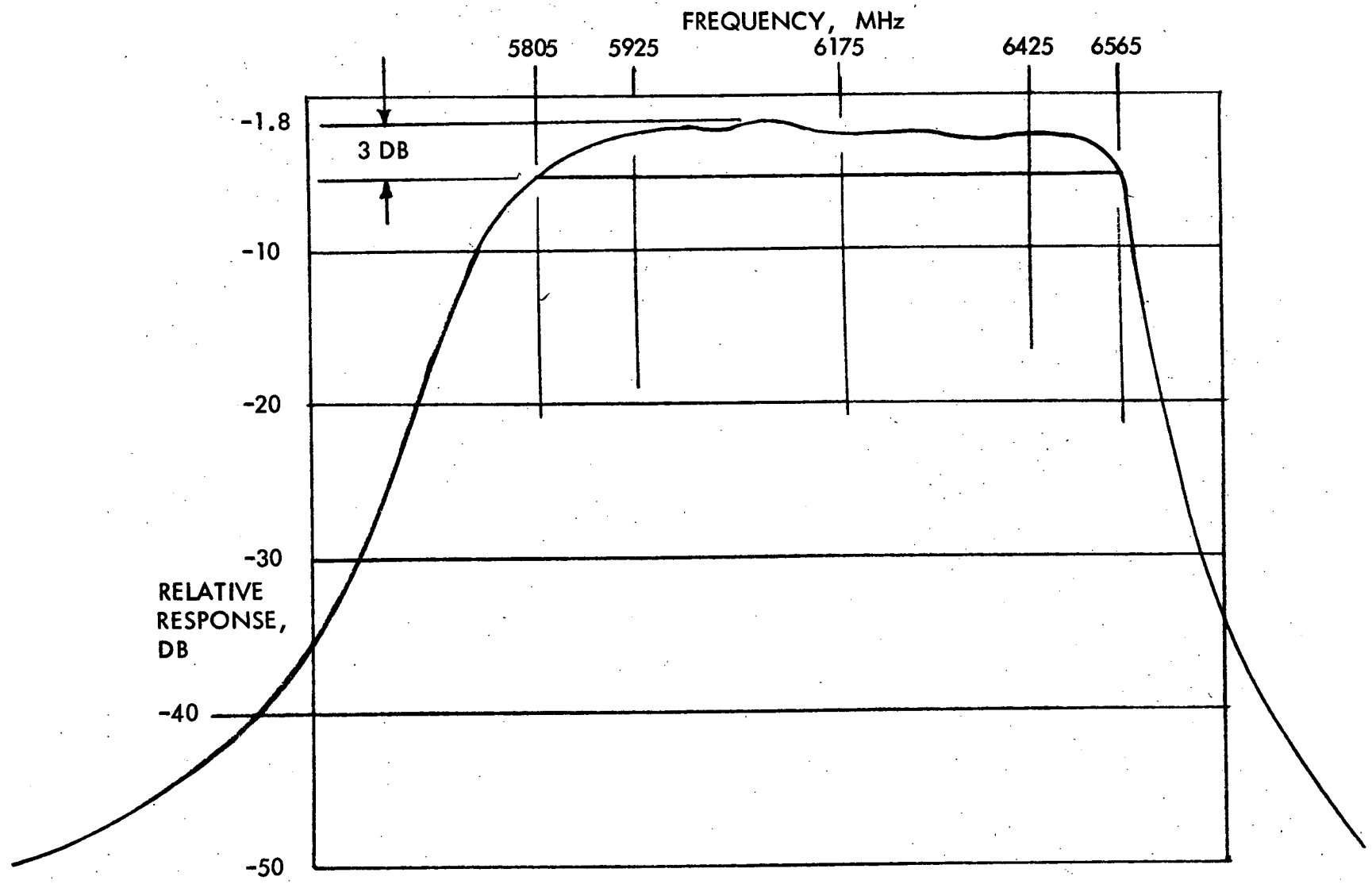


Figure 2-14 5.9 to 6.4 GHz Bandpass Filter, Frequency Response

Frequency	6.0 GHz
Bandwidth	200 MHz
Attenuation	30 dB
VSWR	1.3:1 max.

2.2.11 ADJUSTABLE ATTENUATOR

A Narda, Model 4798, adjustable attenuator was purchased and received to the following specifications:

Frequency	6.0 GHz
Bandwidth	200 MHz
Attenuation	0.5 to 15 dB
VSWR	1.5:1 max.

2.2.12 1 DB STEP ATTENUATOR

A Weinschel, Model 9009, 1 dB step attenuator was purchased and received to the following specifications:

Frequency	6.0 GHz
Bandwidth	200 MHz
VSWR	1.35:1 max.
Range	0 to 9 dB, 1 dB steps
Accuracy	±0.05 dB repeatability

2.2.13 10 DB STEP ATTENUATOR

A Weinschel, Model 9010, 10 dB step attenuator was purchased and received to the following specifications:

Frequency	6.0 GHz
Bandwidth	200 MHz
VSWR	1.35:1 max.
Range	0 to 60 dB, 10 dB steps
Accuracy	±0.05 dB repeatability

3. C-BAND TRANSLATOR/RECEIVER/ATTENUATOR

3.1 BLOCK DIAGRAM ASSEMBLY

The block diagram of the translator/receiver is shown in figure 3-1. The signal levels shown reflect the actual test data. The addition of a band pass filter on the SHF LO output was necessary to reduce spurious outputs.

A photo of the down converter is shown in figure 3-2 and a chassis drawing in figure 3-3.

3.2 COMPONENTS

3.2.1 LOW NOISE AMPLIFIER

The LNA is shown in figure 3-4. A block diagram/schematic is shown in figure 3-5:

	Specification	Performance
Frequency	4.0 GHz	4.0 GHz
Bandwidth	200 MHz (1 dB)	200 MHz (1 dB)
Gain	15 dB min.	12 dB
Noise Figure	5.5 dB max.	5 dB
Input/Output VSWR	1.5:1 max.	

Frequency response photos are shown in figure 3-6.

3.2.2 INPUT ATTENUATOR

A Narda, Model 777C, fixed attenuator was purchased and received to the following specifications:

Frequency	4.0 GHz
Bandwidth	200 MHz
Attenuation	60 dB
VSWR	1.25:1 max.

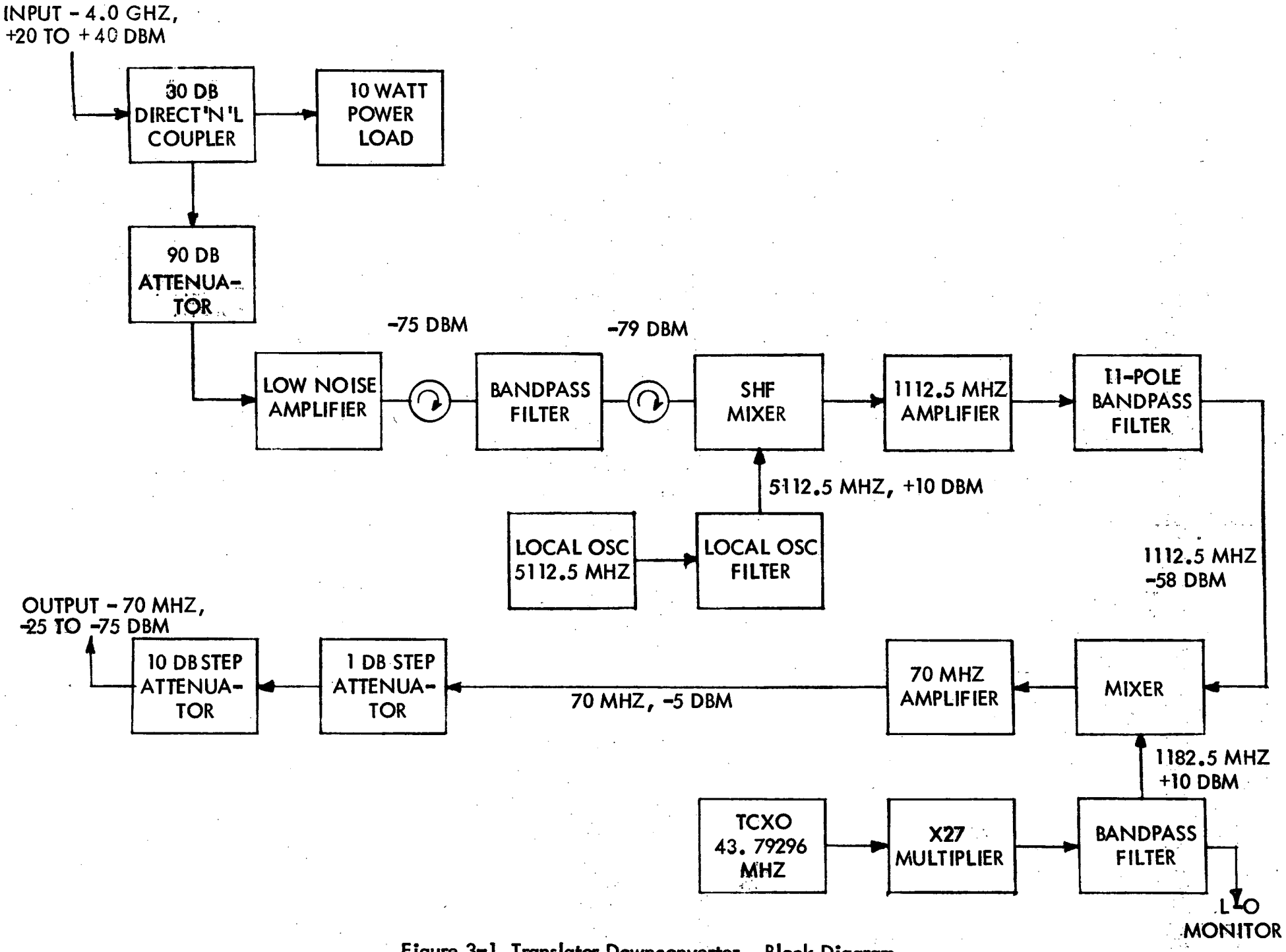


Figure 3-1 Translator Downconverter, Block Diagram

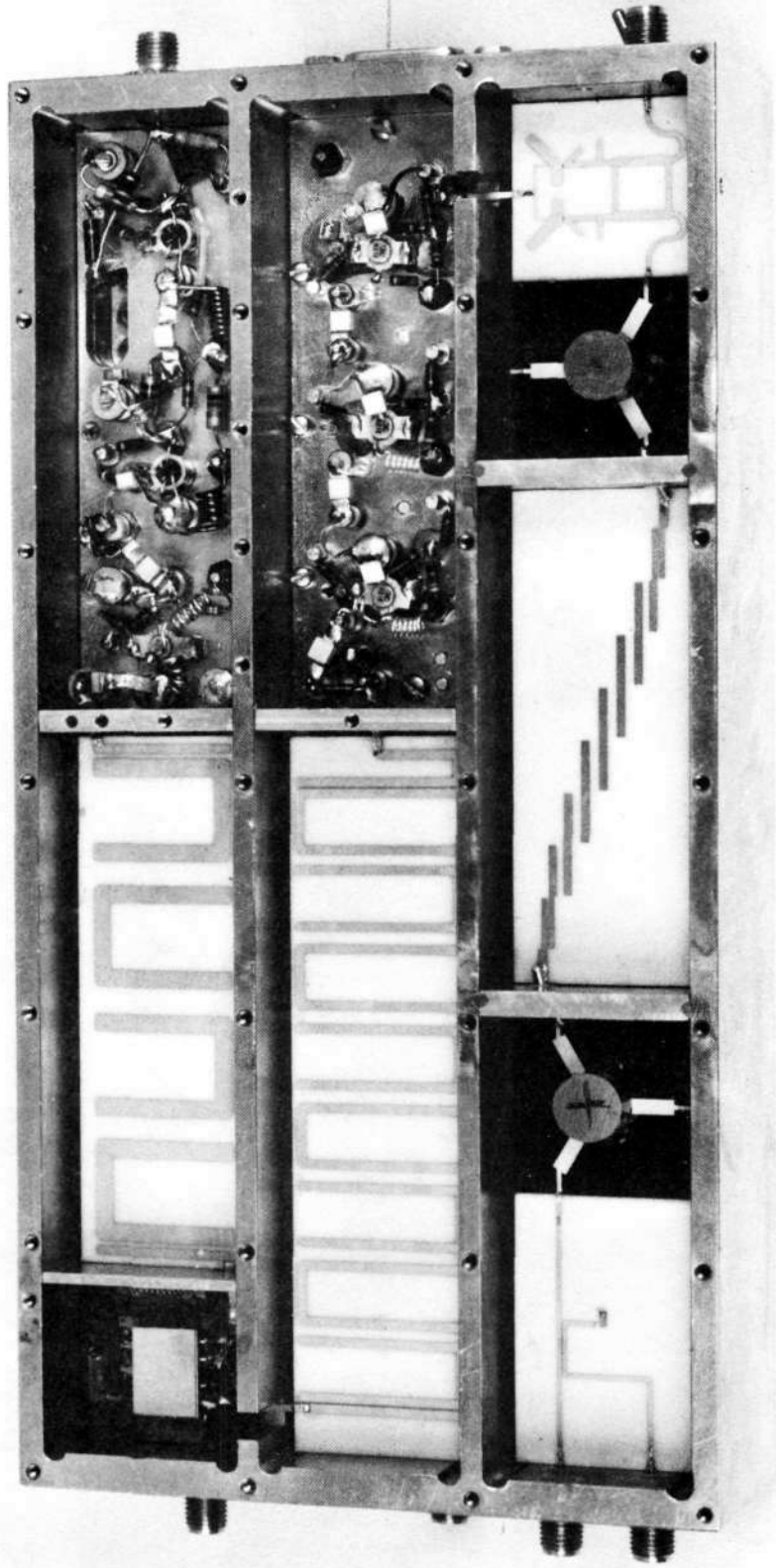
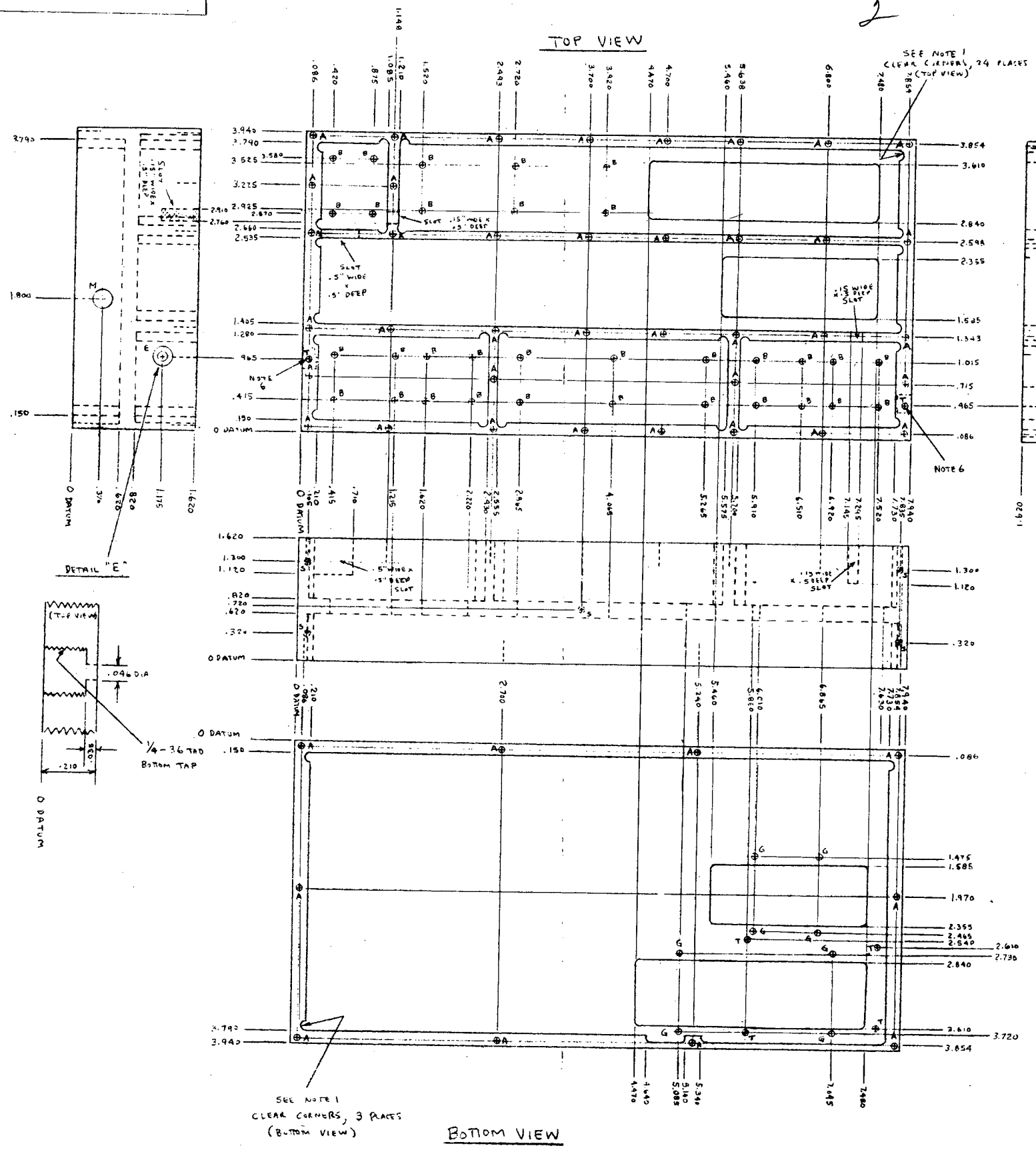


Figure 3-2 Translator Downconverter (68605)

FOLDOUT FRAME 1

FOLDOUT FRAME 2



NOTES

1. ALL RADII $\frac{1}{16}$" R UNLESS OTHERWISE SPECIFIED
2. MATERIAL IS 6061T6 ALUMINUM
3. FINISH IS IRIDITE
4. TOP AND BOTTOM COVERS MADE OF 0.062" ALUMINUM. MATCH DRILL TO CHASSIS TOP AND BOTTOM "A" HOLES
5. CANNON DEM-9P TYPE CONNECTOR TO BE USED IN 1.3 x .5 x .05 PATTERN
6. 8/56 ALLEN SET SCREW TO BE USED TO SECURE RF CONNECTOR IN E HOLE. TAP THRU TO E HOLE

DRILLING SCHEDULE

A	#2 (.086) - 56UNC - 2B TAP, X .3" DEEP
B	CLEARANCE FOR #2(.086) - 56UNC, THRU
E	1/4 - 36 THD, BOTTOM TAP, SEE DETAIL E
G	CLEARANCE FOR 2-56 TAP, C'SINK FOR 82° FLATHEAD SCREW
M	1/4 - 36 THD TAP THRU
C	4-40 THD, TAP THRU
T	#2 (.086) - 56UNC - 2B TAP, THRU
S	4-40 THD, 2B TAP x .4" DEEP

Figure 3-3 Translator Downconverter, Chassis Drawing

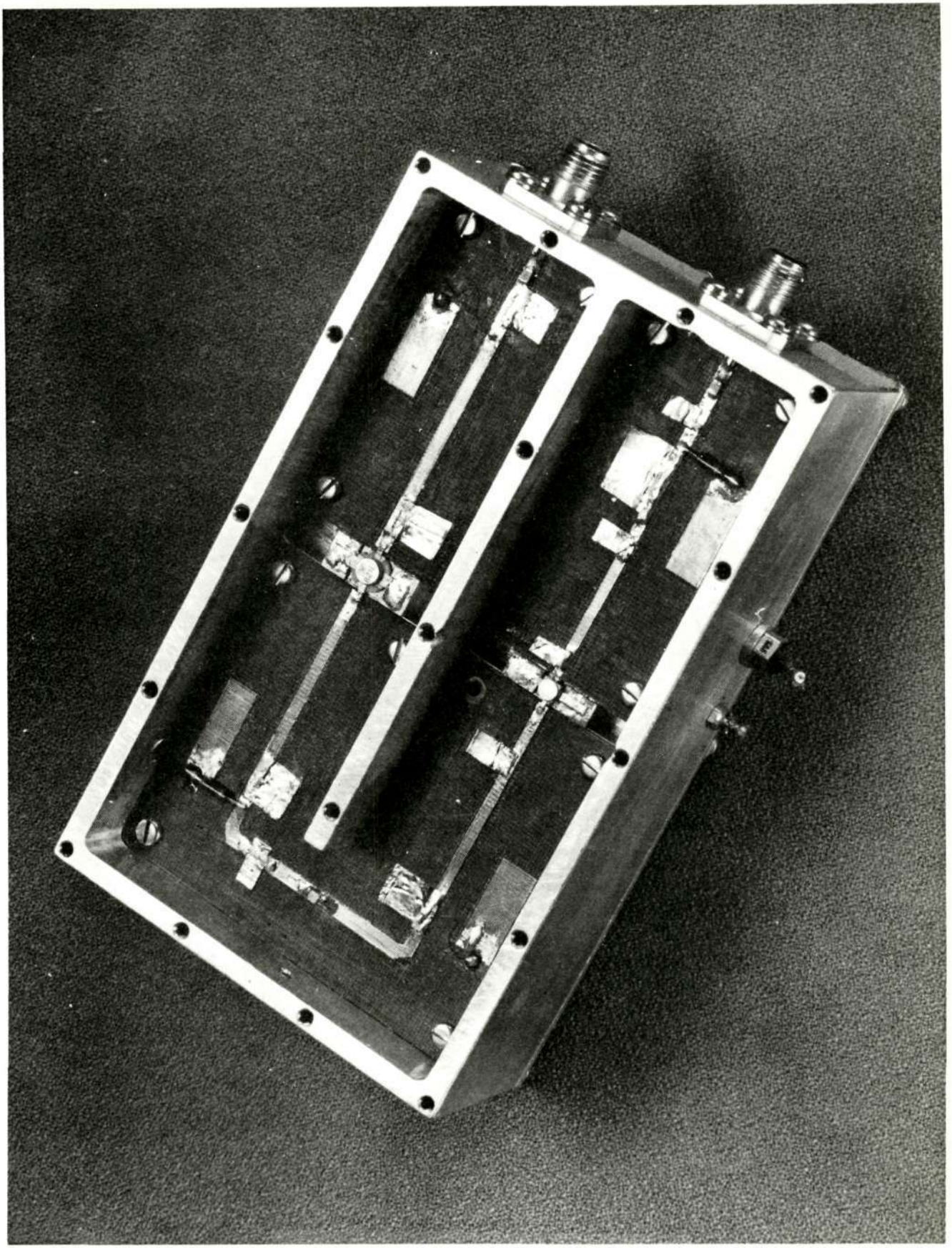


Figure 3-4 Low Noise Amplifier (70622)

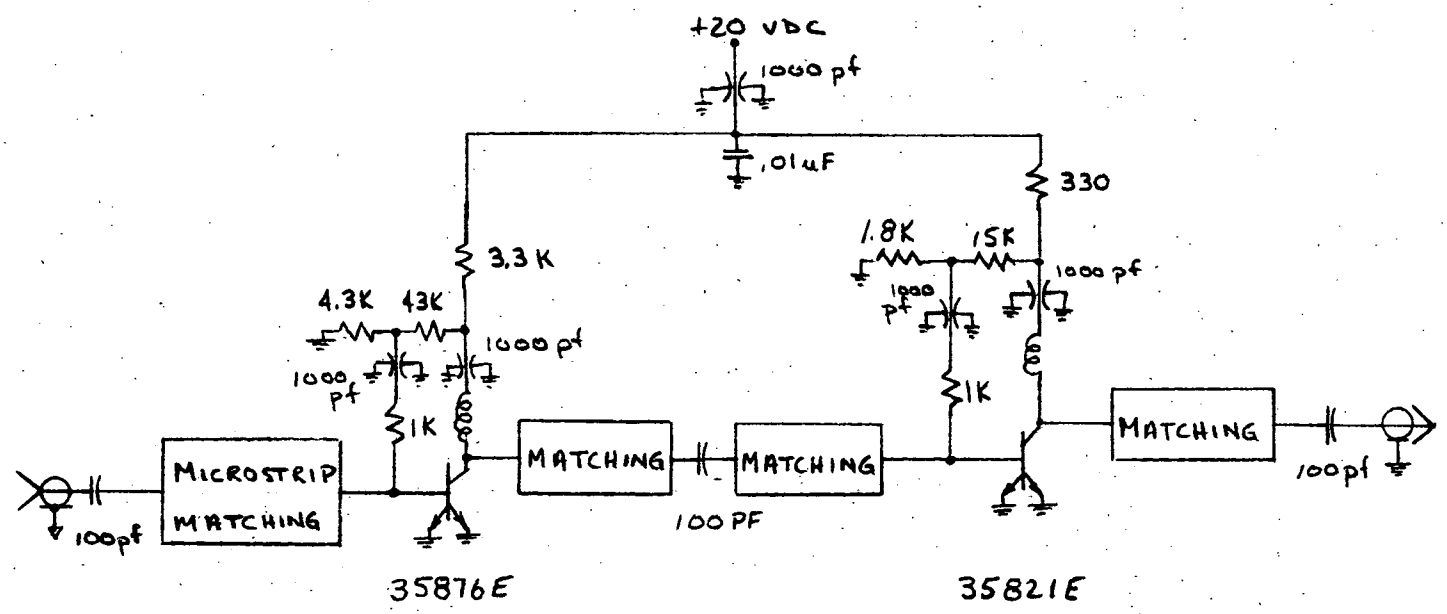
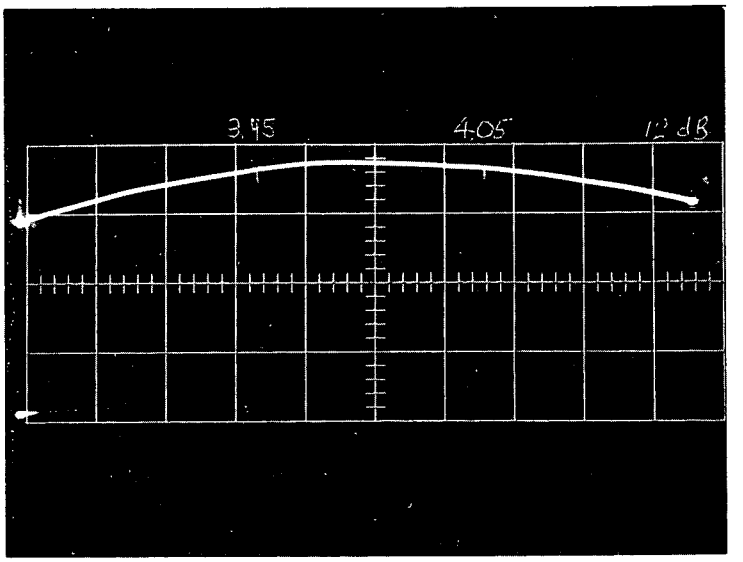


Figure 3-5 4 GHz Low Noise Amplifier, Schematic Diagram



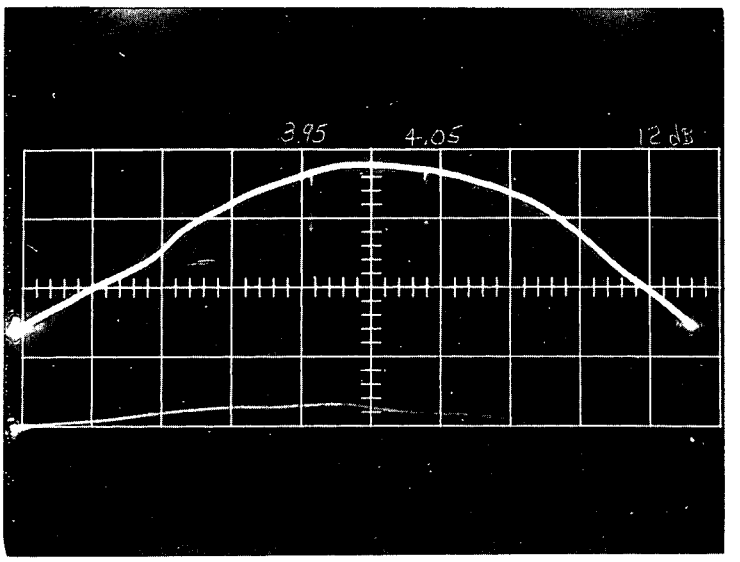


Figure 3-6 4 GHz Low Noise Amplifier Performance

3.2.3 INPUT COUPLER

A Narda, Model 3043B, coupler and a Narda, Model M374NM, 10 watt load were purchased and received to the following specifications:

Frequency	4.0 GHz
Bandwidth	200 MHz
Coupling	30 dB
VSWR	1.2:1 max.
Directivity	27 dB min.

Termination on main line to dissipate 10 watts.

3.2.4 4 GHZ ISOLATOR

The 4 GHz Isolator is shown in figure 3-7. The performance summary for these isolators is listed below:

	Specification	Performance	
Frequency	4.0 GHz	4 GHz	4 GHz
Bandwidth	200 MHz	200 MHz	200 MHz
Insertion Loss	0.6 dB	0.8 dB	0.7 dB
Isolation	20 dB min.	19 dB	22 dB
VSWR	1.2:1 max.	1.25:1	1.33:1

3.2.5 4 GHZ BAND PASS FILTER

The 4 GHz band pass filter is shown in figure 3-8 and a performance curve in figure 3-9. A summary of performance is shown below:

	Specification	Performance
Center Frequency	4.0 GHz	4.0 GHz
Bandwidth	360 MHz	600 MHz
Insertion Loss	.7 dB Alumina	1.2 dB
Rejection	60 dB at 5112.5 MHz	60 dB at 5112.5 MHz
Design	5 Pole, 0.1 dB Tcheby	5 Pole, 0.1 dB Tcheby

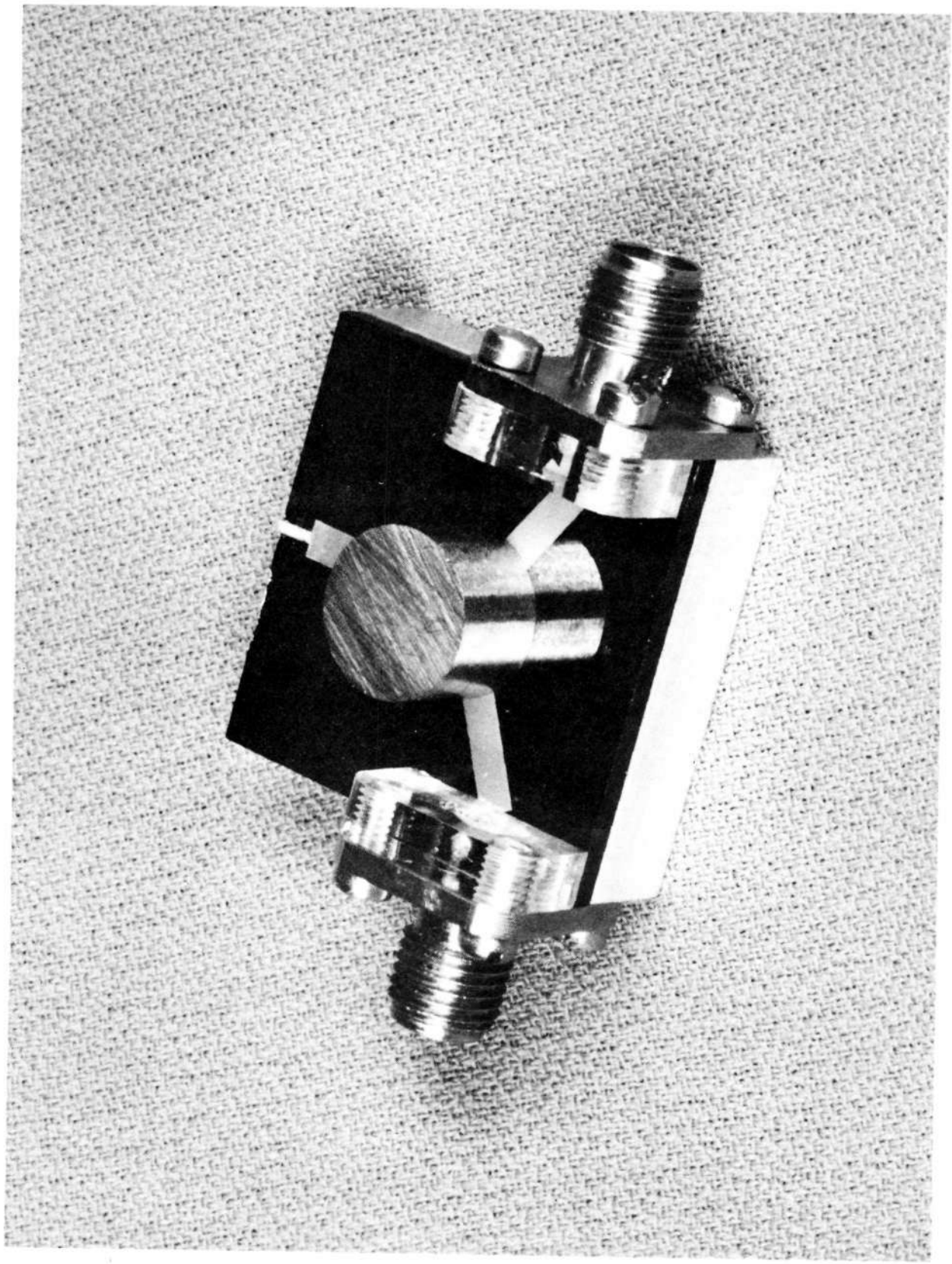


Figure 3-7 4 GHz Isolator (68474)

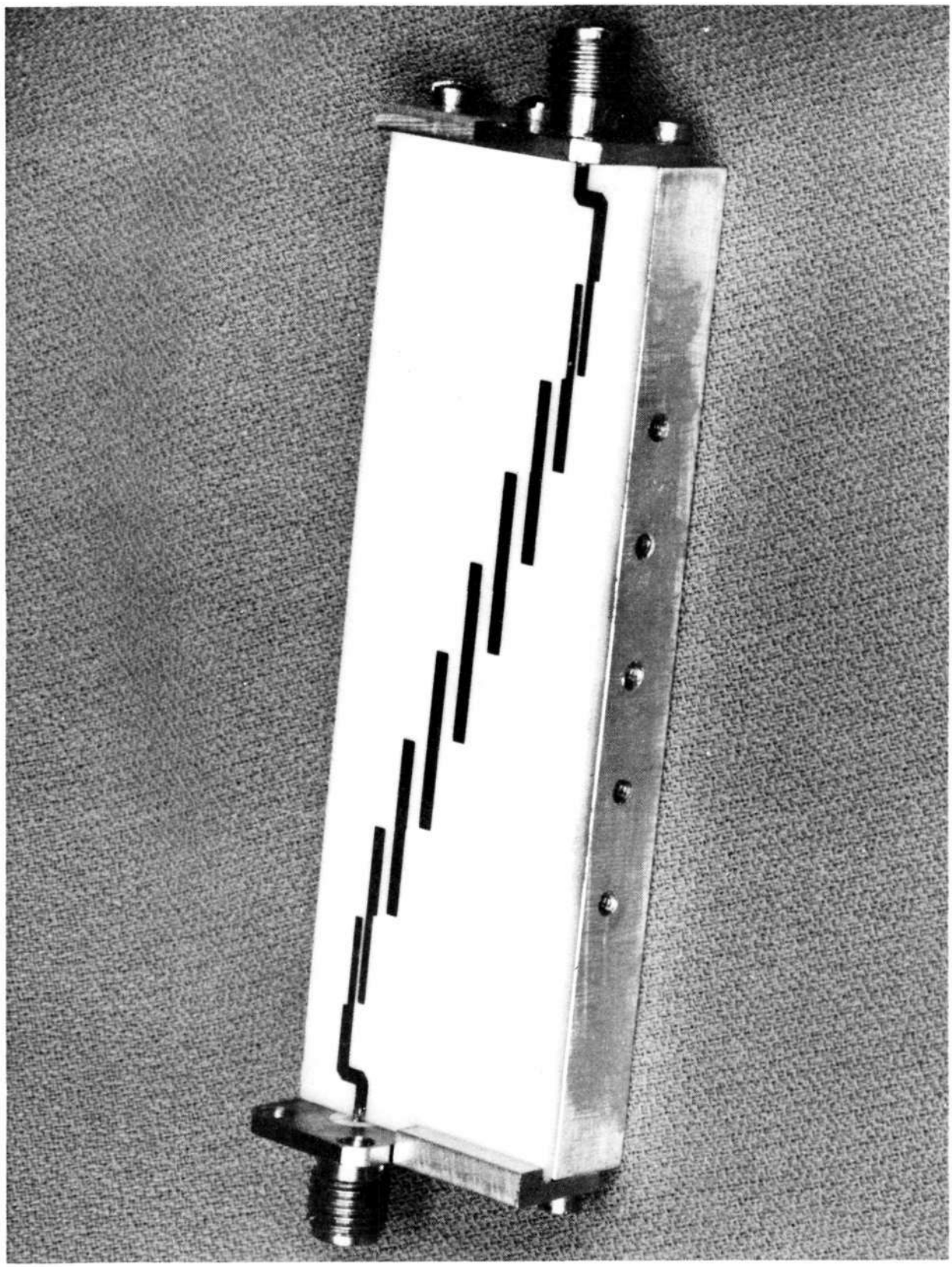


Figure 3-8 4 GHz Bandpass Filter (68475)

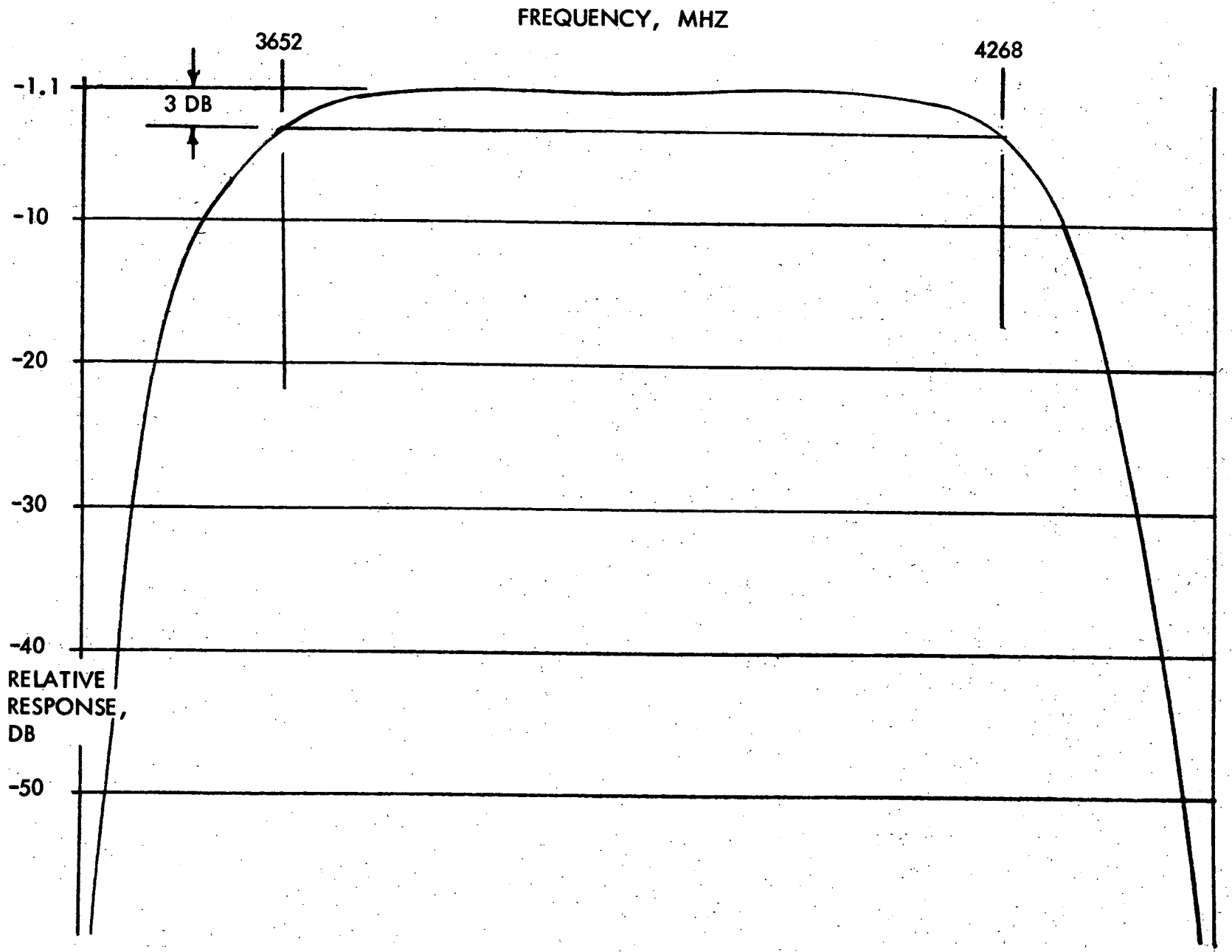


Figure 3-9 3.7 to 4.2 GHz Bandpass Filter Frequency Response

The bandwidth of this filter is wider than required. This does not affect system performance as long as the rejection at 5112.5 MHz is met.

3.2.6 SHF MIXER

The SHF Mixer has been fabricated and tested. The performance of the mixer is summarized below. A photo of the mixer is shown in figure 3-10.

	Specification	Performance
RF Frequency	4.0 GHz	4.0 GHz
Bandwidth	200 MHz	200 MHz
LO Frequency	5112.5 MHz	5112.5 MHz
Noise Figure	6 dB (mixer only)	8 dB (mixer only)
LO Power	+10 to +13 dBm	+10 to +13 dBm

The higher mixer noise figure is not a problem because of the input LNA.

3.2.7 SHF LO

A Frequency Sources, Model FS-30, oscillator was purchased to the following specifications:

Output Frequency	5112.5 MHz
Output Power	+10 dBm
Output VSWR	1.5:1 max
Frequency Stability	±.0015%
Spurious	65 dB below output level in ±200 MHz band around f_o.

A copy of the manufacturers test data is shown in figure 3-11.

3.2.8 1112.5 MHz IF AMPLIFIER

The 1112.5 MHz amplifier schematic is shown in figure 3-12 and a photo in figure 3-13. The performance summary is shown below for reference:

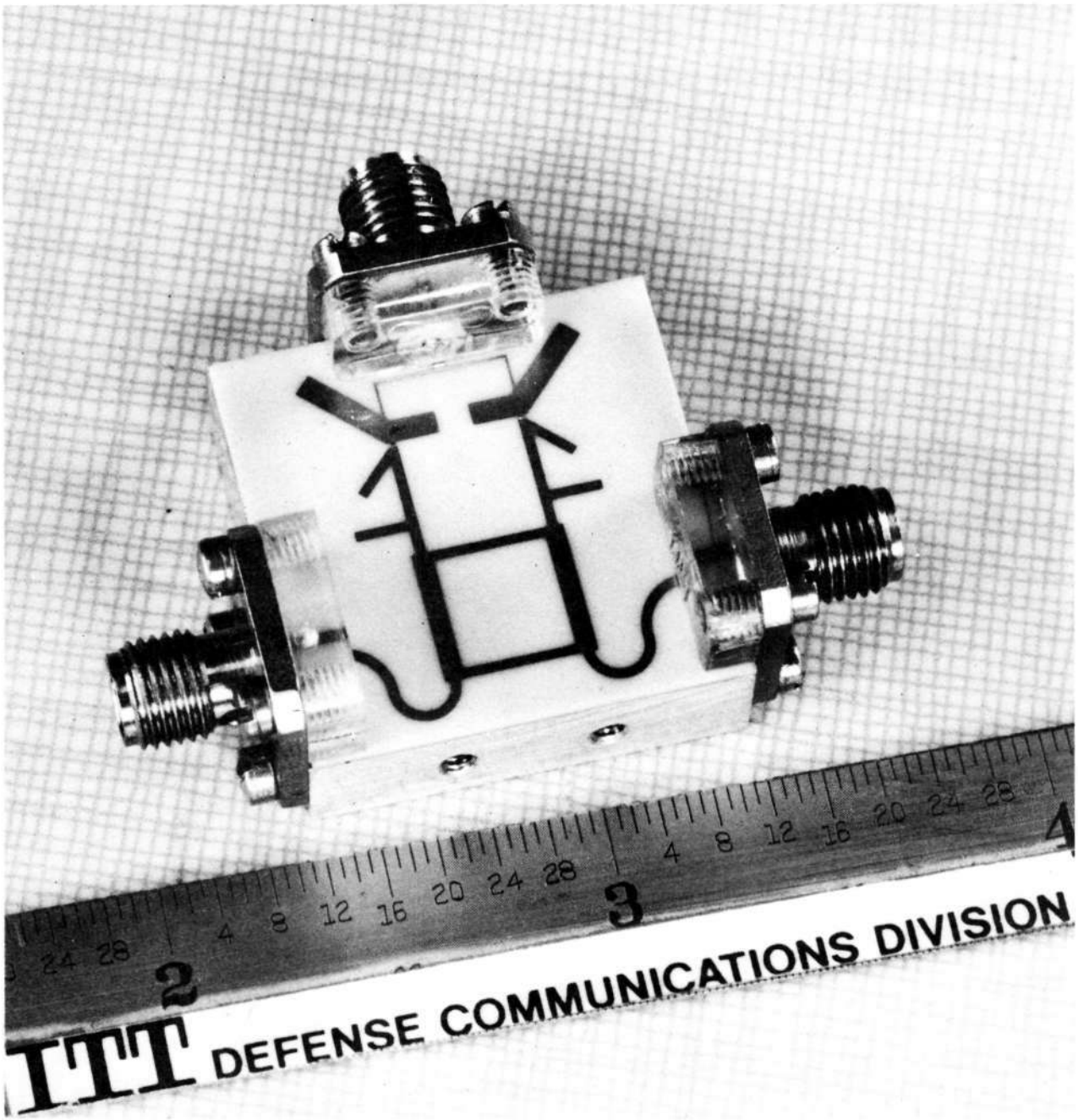


Figure 3-10 4 GHz Mixer (68449)

CUSTOMER ITT
P.O. NO. 580310
CUST. NO. 3266
F[illegible]. 5112.5 MHZ
UNIT NO. FS-30

Frequency Sources Inc.
KENNEDY DRIVE • P.O. BOX 159
NORTH CHELMSFORD, MASS. 01863

SER. NO. 8001
DATE 10/4/72

TEST DATA SHEET

TEMPERATURE	FREQUENCY	POWER
0 °C	5112.5500 MHZ	18.0 Mw
+25 °C	5112.5750 MHZ	18.5 Mw
+60 °C	5112.4600 MHZ	14.0 Mw

Spurious Rejection: ✓ OK

2:1 Mismatch Check: ✓ OK

D.C. Power +15 VDC @ 85 Ma.

Fig 3-11

Figure 3-11 4 GHz Local Oscillator Manufacturer's Data Sheet

OPERATING VOLTAGE _____ AT _____ MA.

TECH: [illegible]
Q.C.: [illegible]

FOLDOUT FRAME

1

PARTS LIST

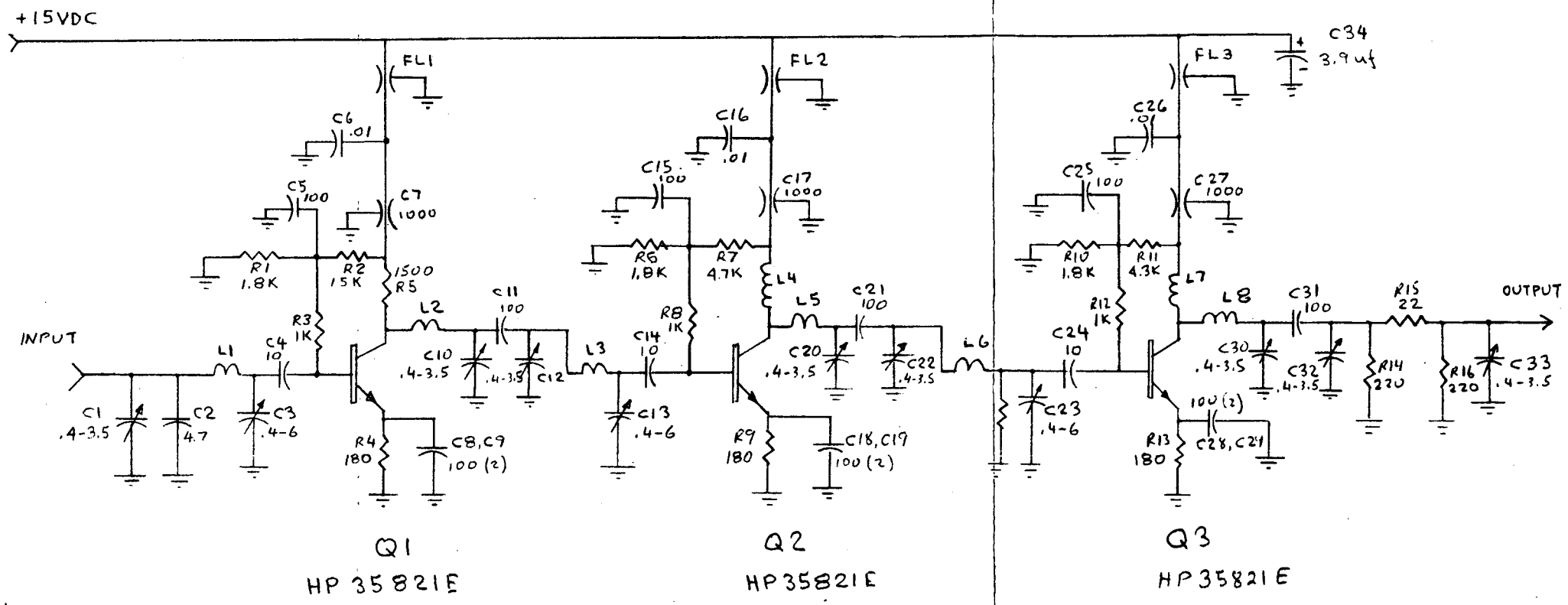
R1 Resistor, Carbon. 1.8 Kohm, 1/8 WATT, ± 5%
R2 Resistor, Carbon. 15 Kohm. 1/8 WATT. ± 5 %
R3 Resistor, Carbon. 1000 ohm, 1/8 WATT. ± 5%
R4 Resistor, Carbon. 180 ohm. 1/8 WATT. ± 5%
R5 Resistor, Carbon, 1500 ohm, 1/8 WATT. ± 5%
R6 Resistor, same as R1
R7 Resistor. Carbon. 4.7 Kohm, 1/8 WATT. ± 5%
R8 Resistor, same as R3.
R9 Resistor, same as R4.
R10 Resistor, same as R1.
R11 Resistor, Carbon. 4.3 Kohm, 1/8 WATT. ± 5%
R12 Resistor, same as R3.
R13 Resistor, same as R4.
R14 Resistor, Carbon. 220 ohm, 1/8 WATT, ± 5%
R15 Resistor, Carbon, 22 ohm. 1/8 WATT, ± 5%
R16 Resistor, same as R14.

Q1 Transistor. NPN. MICROWAVE, HP 35821E
Q2 Transistor. same as Q1
Q3 Transistor, same as Q1

C1 CAPACITOR, variable. .4-3.5pf Johanson 5802
C2 Capacitor, fixed, 4.7pf, ATC100-B-4R7-K-MS
C3 Capacitor, variable, .4-6pf, Johanson 5702
C4 Capacitor, fixed, 10pf. ATC100-B-10-K-MS
C5 Capacitor, Fixed, 100pf. ATC100-B-100-K-MS
C6 Capacitor, Ceramic, .01uf CKR06CW103K
C7 Capacitor, Feed Thru, 1000pf, Erie 2425-003
C8 Capacitor, same as C5.
C9 Capacitor, same as C5.
C10 Capacitor, same as C1.
C11 Capacitor, same as C5.
C12 Capacitor, same as C1.
C13 Capacitor, same as C3.
C14 Capacitor, same as C4.
C15 Capacitor, same as C5.
C16 Capacitor, same as C6.
C17 Capacitor, same as C7.
C18 Capacitor, same as C5.
C19 Capacitor, same as C5.
C20 Capacitor, same as C1.
C21 Capacitor, same as C5.
C22 Capacitor, same as C1.
C23 Capacitor, same as C3
C24 Capacitor, same as C4

FOLDOUT FRAME

2



C25 Capacitor, same as C5.
C26 Capacitor, same as C6.
C27 Capacitor, same as C7.
C28 Capacitor, same as C5
C29 Capacitor, same as C5.
C30 Capacitor, same as C1.
C31 Capacitor, same as C5.
C32 Capacitor, same as C1.
C33 Capacitor, same as C1
C34 Capacitor, Fixed, 3.9uf, 35VDC KEMET CSR13H39KP.

FL1 FILTER, Line, FILTERCON ERIE-1270-009.
FL2 FILTER, same as FL1.
FL3 FILTER, same as FL1.

L1 INDUCTOR, STRIP, 0.5" LONG, .075 WIDE GOLD PLATED BRASS STRIP .007" THK
L2 INDUCTOR, 2 TURNS #22 SILVER WIRE, .070" ID, 1/8" LONG
L3 INDUCTOR, STRIP, 0.4" LONG, .075 WIDE GOLD PLATED BRASS STRIP .007" THK
L4 INDUCTOR, 6 TURNS #22 SILVER WIRE, .070" ID, .4" LONG
L5 INDUCTOR, same as L2.
L6 INDUCTOR, same as L3.
L7 INDUCTOR, same as L4.
L8 INDUCTOR, 4½ TURNS #22 SILVER WIRE, .070" ID .4" LONG.

LOW NOISE - WIDE BAND
PRE-AMP FOR DOWN CONVERTER
CENTER FREQ - 1112.5 MHz
NOMINAL GAIN - 40 dB

Figure 3-12 1112.5 MHz Downconverter Amplifier, Schematic Diagram

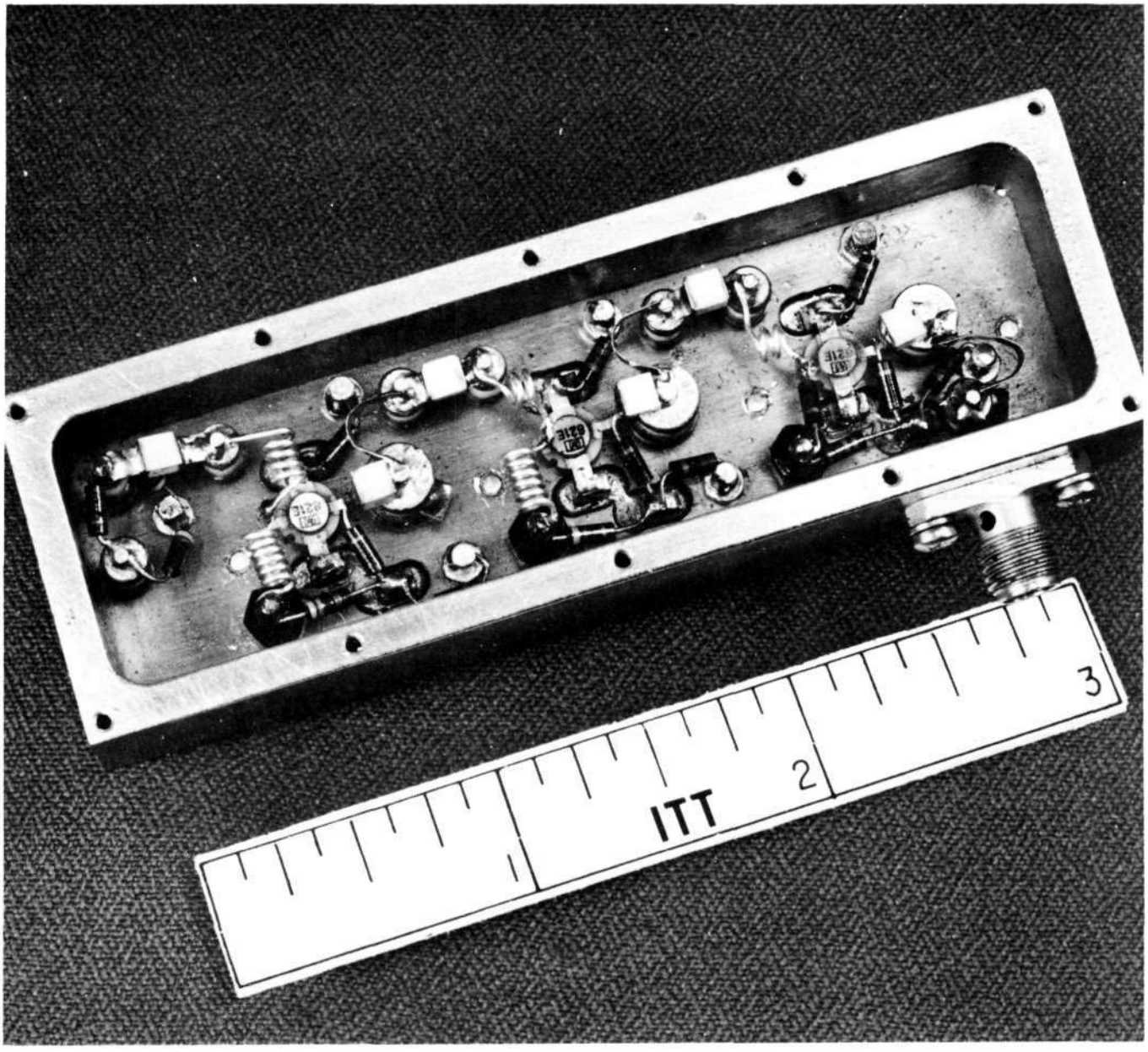


Figure 3-13 1112.5 MHz Downconverter Amplifier (70363)

	Specification	Performance
Center Frequency	1112. 5 MHz	1112. 5 MHz
Bandwidth	100 MHz	100 MHz
Gain	40 dB	32 dB
Noise Figure	3 dB	_____*
Input VSWR	1. 5:1 max.	1. 5:1 ma
Output VSWR	1. 2:1 max.	1. 5:1

* Noise Figure of preamp without mixer was not measured.

3. 2. 9 1112. 5 MHZ IF FILTER

The 1112. 5 MHz IF Filter photo is shown in figure 3-14 and a performance curve is shown in figure 3-15. A performance summary is shown below:

	Specification	Performance
Center Frequency	1112. 5 MHz	1112. 5 MHz
Bandwidth	100 MHz	100 MHz
Design	8 Pole, 0. 1 dB Tcheby	8 Pole, 0. 1 dB Tcheby
Loss	4 dB	2. 5 dB

3. 2. 10 1112. 5 MHZ MIXER

An Anzac, Model MD-113, mixer was purchased and received to the following specifications:

RF Frequency	1112. 5 MHz
RF Bandwidth	100 MHz
LO Frequency	1182. 5 MHz
LO Power	+7 to +10 dBm
IF Output Frequency	70 MHz
Conversion Loss	8 dB
LO/IF Isolation	20 dB min.
LO/RF Isolation	25 dB min.

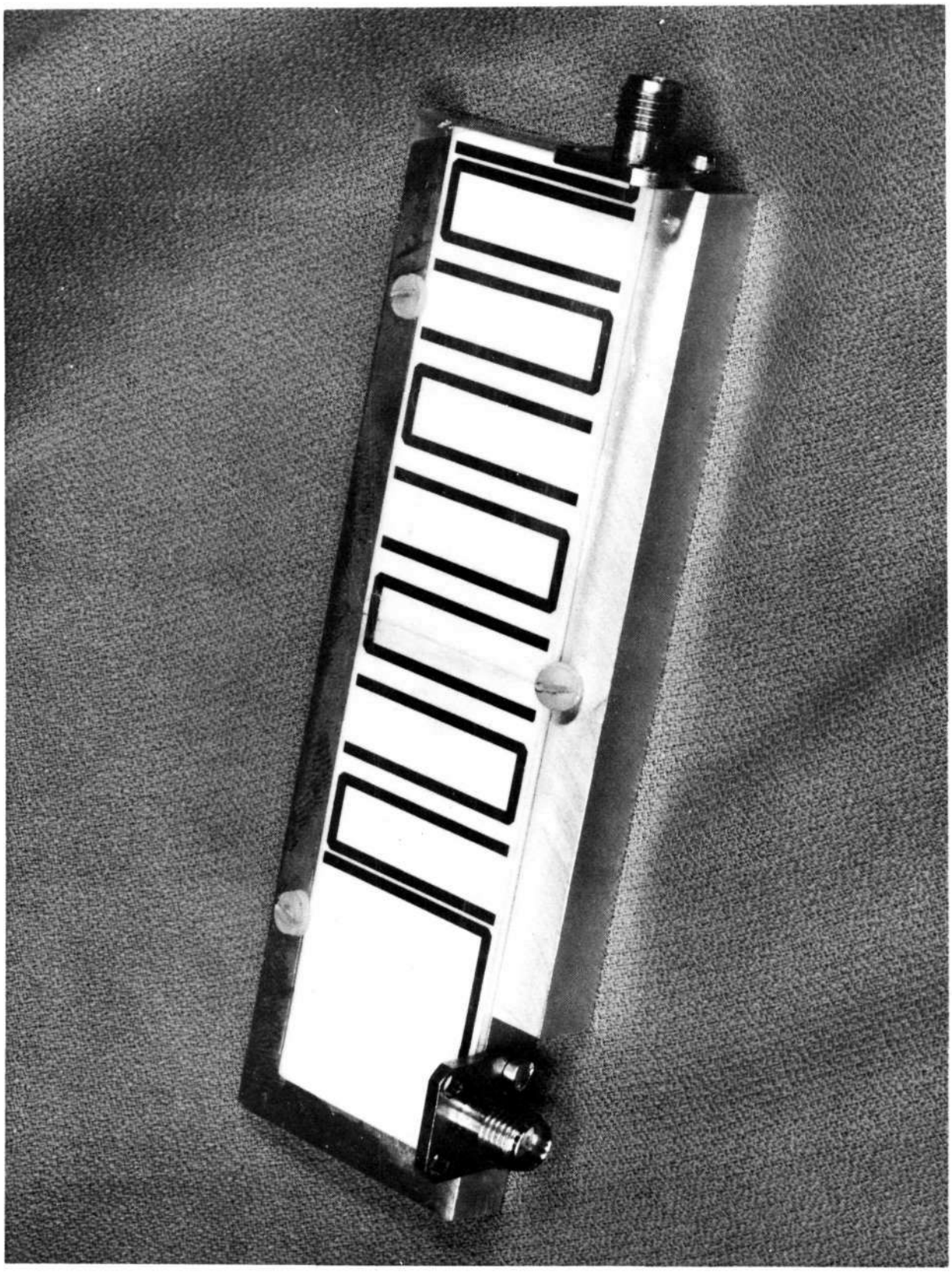


Figure 3-14 1112.5 MHz Downconverter Filter (68476)

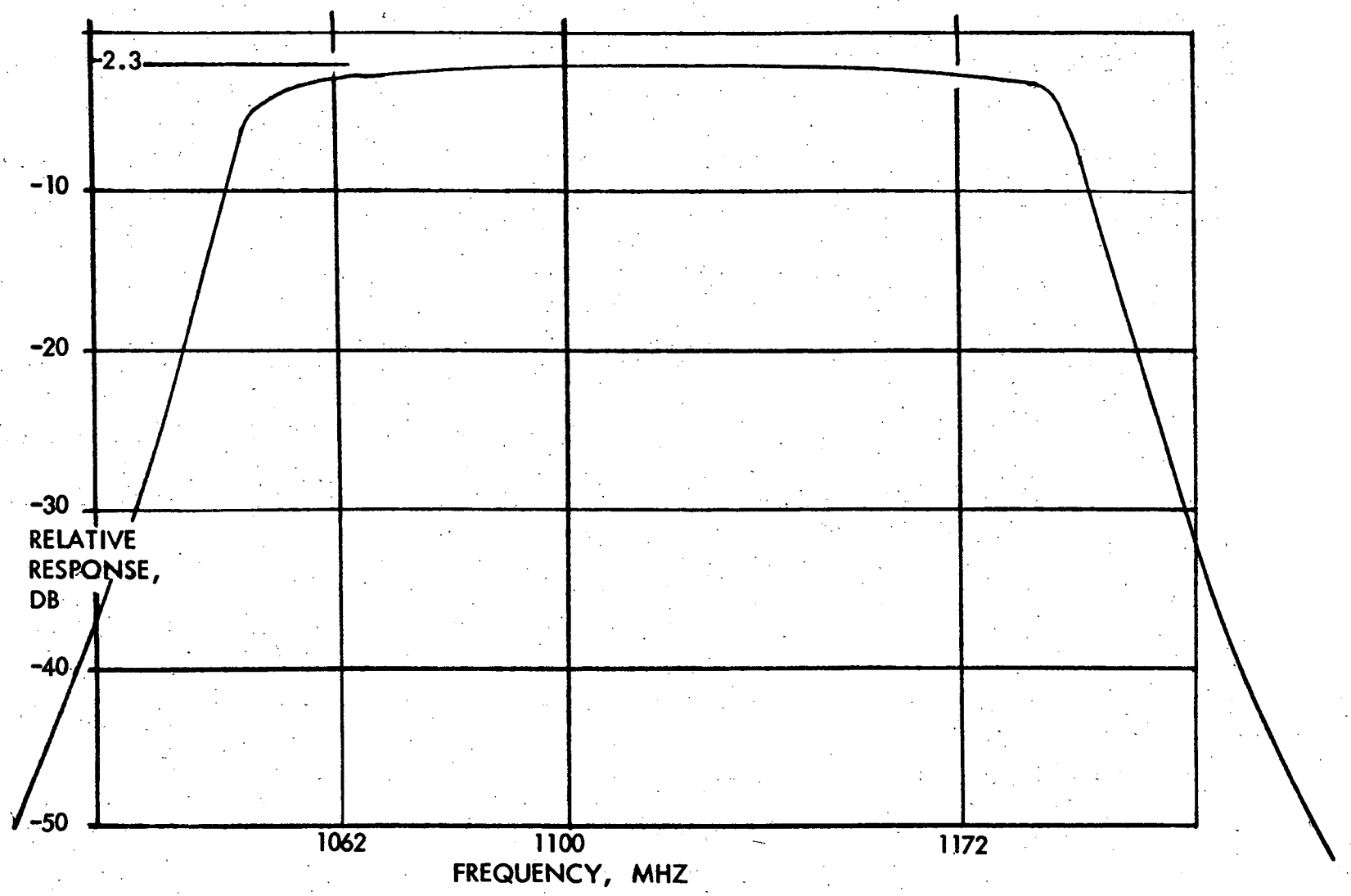


Figure 3-15 Downconverter Filter Response

3.2.11 1182.5 MHZ LO

The TCXO was purchased from CTS Knights (Model 9703233). A photo of the X27 multiplier is shown in figure 3-16. The schematic for the X27 multiplier is identical to that of figure 2-4. The LO output filter is shown in the photo of figure 3-17 and a performance curve in figure 3-18. The performance specification for the LO is shown below for reference:

Output Frequency	1182.5 MHZ
Output Level	+10 DBM
Frequency Stability	$\pm$.0001%
Spurious Outputs	85 DB below nominal output
Monitor Output	-2 DBM

3.2.12 70 MHZ IF AMPLIFIER

The 70 MHz IF Amplifier consists of three Avantek GPD-401 amplifiers in cascade. These amplifiers have been purchased and received. The 70 MHz amplifier performance is shown below:

Frequency	70 MHz
Bandwidth	100 MHz (1 DB)
Gain	42 DB
Input/Output VSWR	1.5:1 max.

Due to lower gain in the 1112.5 MHz IF amplifier and higher mixer conversion loss than originally specified an additional amplifier stage was needed to meet the system gain requirements. An Amperex Model ATF-419 amplifier was used to provide an additional 15 DB of gain over the 20 to 120 MHz bandwidth required with no increase in gain variation with frequency.

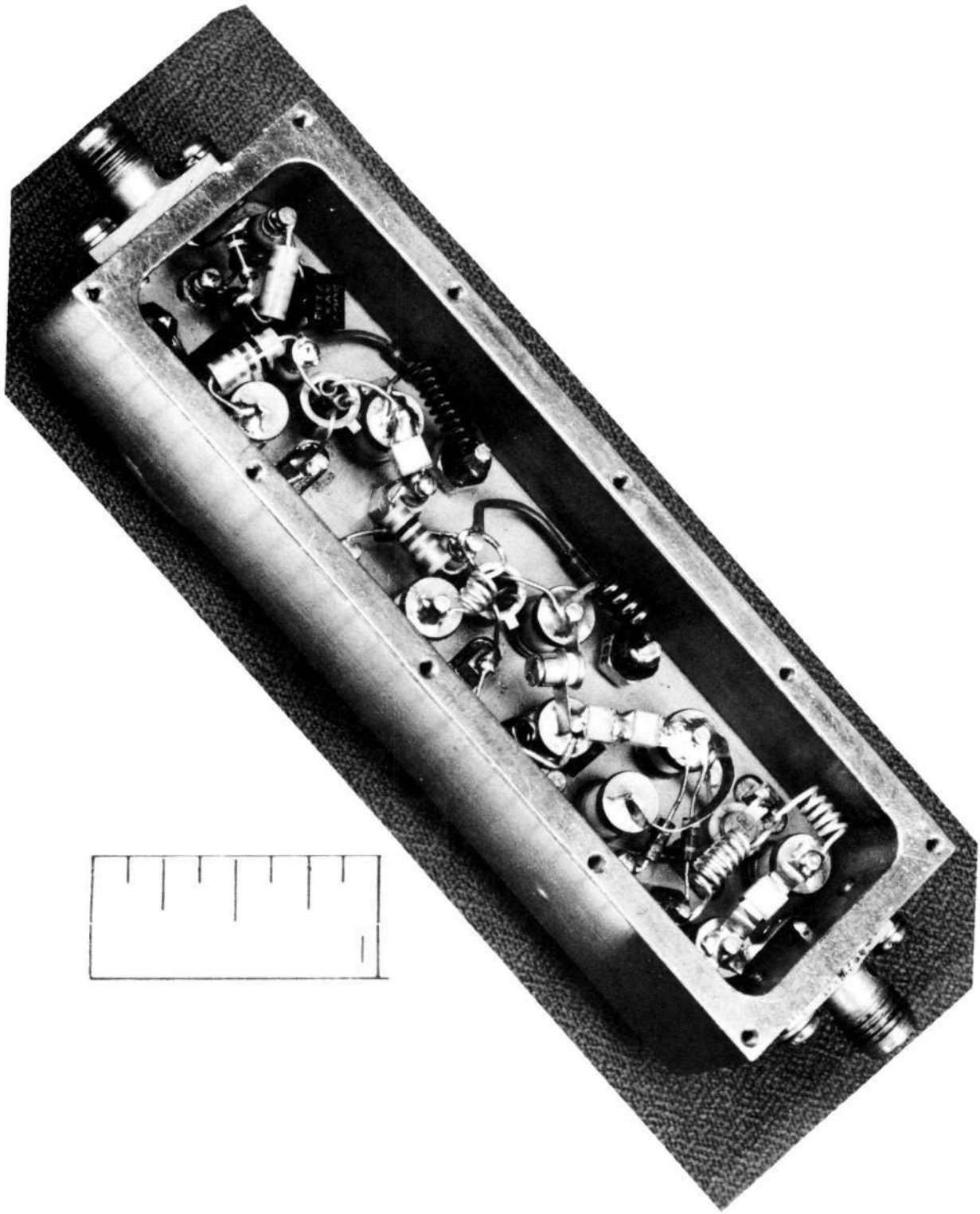


Figure 3-16 Downconverter X27 Multiplier (70359)

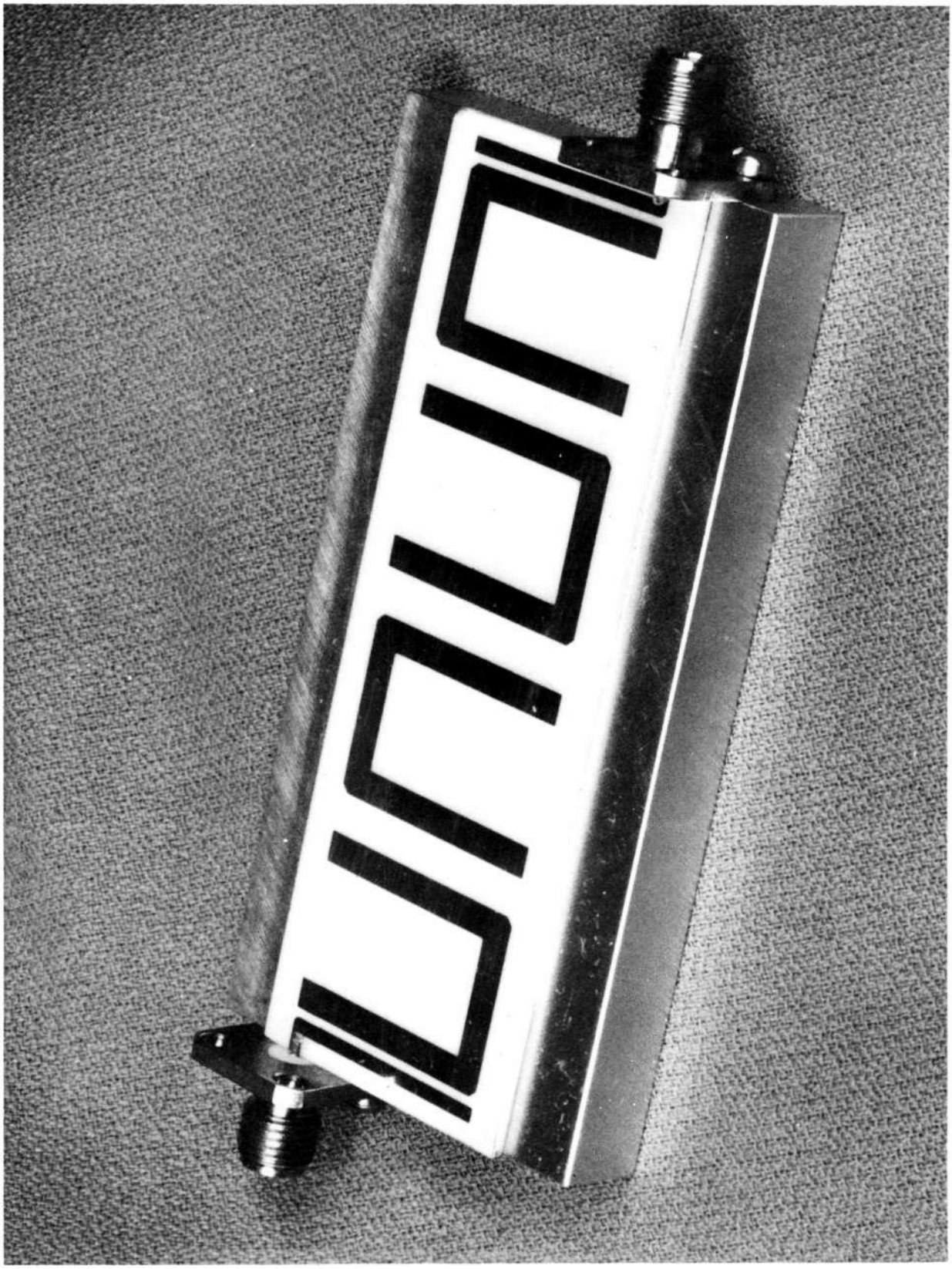


Figure 3-17 1182.5 MHz Downconverter Filter (68477)

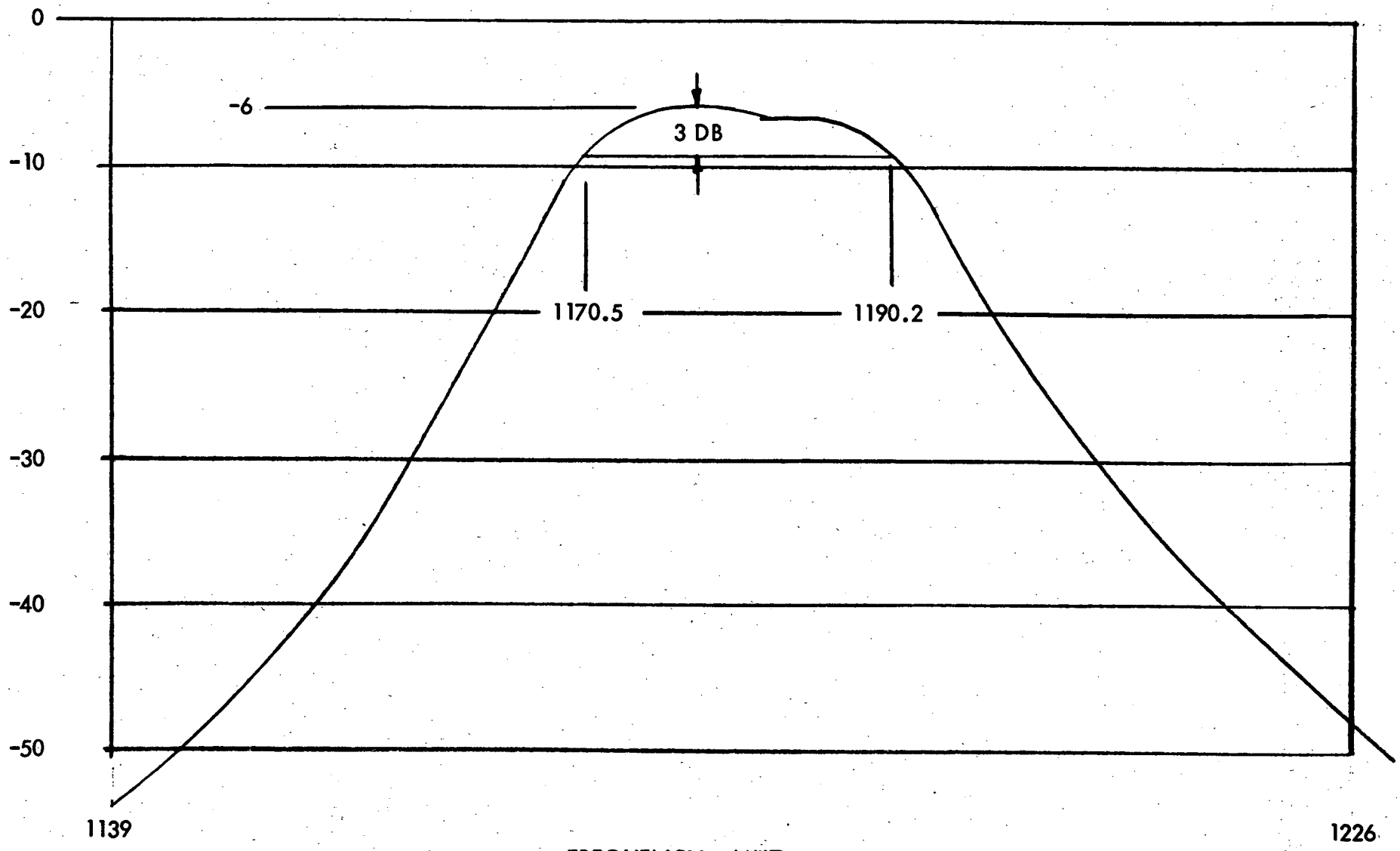


Figure 3-18 1170.5 to 1190.2 Bandpass Filter Frequency Response

3.2.13 1 DB STEP ATTENUATOR

A Texscan, Model RA-50, 1 DB step attenuator was purchased and received to the following specification:

Frequency	70 MHz
Bandwidth	100 MHz
VSWR	1.2:1
Range	0 to 10 DB, 1 DB steps
Accuracy	$\pm$ 0.1 DB

3.2.14 10 DB STEP ATTENUATOR

A Texscan, Model RA-51, 10 DBstep attenuator has been purchased and received to the following specifications:

Frequency	70 MHz
Bandwidth	100 MHz
VSWR	1.2:1
Range	0 to 70 DB, 10 DB steps
Accuracy	$\pm$ 0.2 DB

4. SYSTEM PERFORMANCE DATA

This section includes the Test Data Sheets for the CTB Translator, and test data sheets for the TCXO and SHF Step Attenuator

ACCEPTANCE
TEST DATA SHEETS
FOR
SPACECRAFT COMMUNICATIONS TERMINAL
BREADBOARD COMPONENTS

TEST PROCEDURE DOCUMENT
FOR THE

NASA
MANNED SPACE FLIGHT CENTER
HOUSTON, TEXAS

CONTRACT NAS9-12984

PREPARED BY:

Advanced Development Department

ITT Defense Communications
492 River Road
Nutley, New Jersey 07110

15

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.
CHECKED BY E. W. Hermier 2/15/73	A	28528	1165304
	REV. —		SHEET 1 of 7

DRAWING NUMBER

ITT DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

ACCEPTANCE

TEST DATA SHEET

Applicable Documents:

(1) Exhibit "A"
End Item Specification for
Spacecraft Communication Terminal
Breadboard Components
April 1972

(2) Test Procedure Document for the
NASA Manned Space Flight Center
Houston, Texas
Contract NAS9-12984
ITT Drawing Number A1165313, 14 sheets

		Date
ITTDCD Engineering	Eugen W. Niemiec	2/9/73
ITTDCD Engineering	W. Shamey	2/9/73
ITTDCD Quality Assurance	E. Baranyi (ITT 49 ACD)	2/9/73
NASA Representative		

NOTE: All test equipments used throughout are in current calibration, except noise tube which has calibration due date 11/15/72.

16

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.
CHECKED BY	A	28528	1165304
	REV. ←	SHEET 2 of 7	

DRAWING NUMBER

DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

ACCEPTANCE

TEST DATA SHEET

C-Band Translator Up-Converter

2.1 Input Impedance and VSWR

Frequency in MHz	Return Loss in dB
20	26
30	27
40	34
50	33
60	26
70	26
80	30
90	> 35
100	29
110	26
*120	> 30

* NARDA DIRECTIONAL COUPLER USED FOR THIS MEASUREMENT

2.2 Output Signal Characteristics

70 MHz Input Level	6 GHz Output Level
+10 dBm	-70 dBm (ATTENUATOR SET TO 20 dB)
+10 dBm	* -100 dBm (ATTENUATOR SET TO 50 dB)
0 dBm	-70 dBm (ATTENUATOR SET TO 10 dB)
0 dBm	* -100 dBm (ATTENUATOR SET TO 40 dB)

* ANALYZER NOISE FLOOR = -110 dBm

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.
	A	28528	1165304
CHECKED BY		REV. -	SHEET 3 of 7

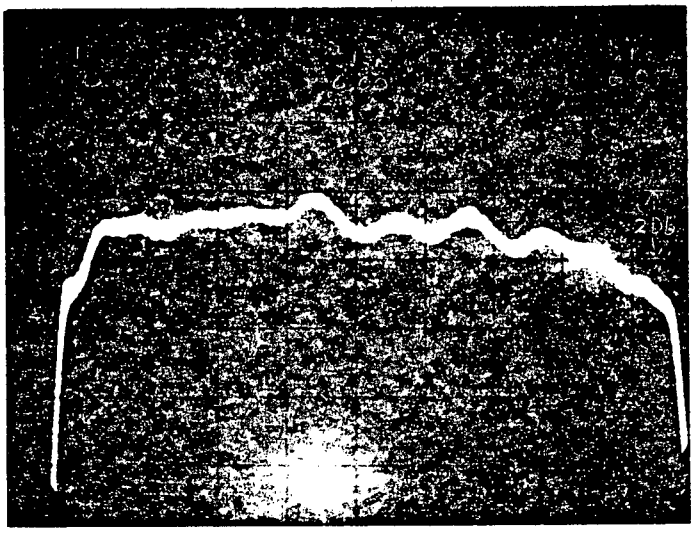
ITT DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

ACCEPTANCE
TEST DATA SHEET

C-Band Translator Up-Converter

2.3 Bandwidth

SWEEP FREQUENCY RESPONSE



P_{IN} = 0 dBm
VERT CAL = 2dB/cm
FREQ AS MARKED

2.4 Frequency Stability

Spec ± .0015% (±90.45 KHz centered on 6.030 GHz)

		Time (Est)		Xtal Oscillator Frequency		SHF Output Frequency
(1)	Start	0945		100.0006 MHz		6.029972 GHz
(2)		1000		100.0006 "		6.029963 "
(3)		1015		100.0006 "		6.029959 "
(4)		1030		100.0006 "		6.029958 "
(5)		1045		100.0006 "		6.029959 "
(6)		1100		100.0006 "		6.029960 "
(7)		1115		100.0006 "		6.029960 "
(8)		1130		100.0006 "		6.029961 "
(9)	End	1145		100.0006 "		6.029963 "

TOTAL DRIFT = 14 KHz

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.	
	A	28528	1165304	18
CHECKED BY		REV. -		SHEET 4 of 7

ACCEPTANCE
TEST DATA SHEET

C-Band Translator Up-Converter

2.5 Spurious Outputs

70 MHz Input Level	Spurious Outputs in 5.950 to 6.050 GHz bandwidth
0 dBM	NONE FOUND *
+10 dBm	NONE FOUND *

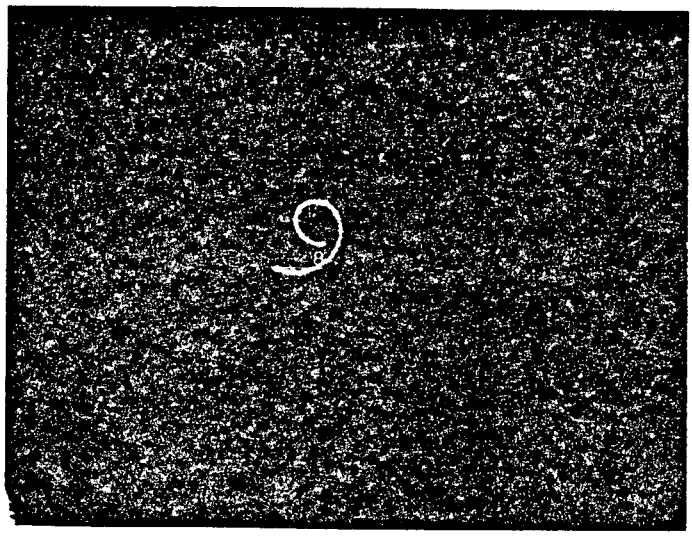
* ANALYZER NOISE FLOOR = -112 dBm

(0dBm ANALYZER SETTINGS) HORIZONTAL CALIBRATION = .5 MHz/CM, SCAN TIME = 10SEC/CM, IF BANDWIDTH = 1KHZ, 100 Hz VIDEO FILTER IN

(+10dBm ANALYZER SETTINGS) HORIZONTAL CALIBRATION = 1MHz/cm, SCAN TIME = 5sec/cm, IF BANDWIDTH = 3 KHz, 100 Hz VIDEO FILTER IN

ADDITIONAL UP-CONVERTER DATA

2.6 SHF Output Impedance



P = 1 (FULL SCALE
SWEEP, 5.95 TO 6.05GHz
Z_o = 50 Ω

DWG. NO. 1165304

SHEET 5 of 7

DRAWING NUMBER

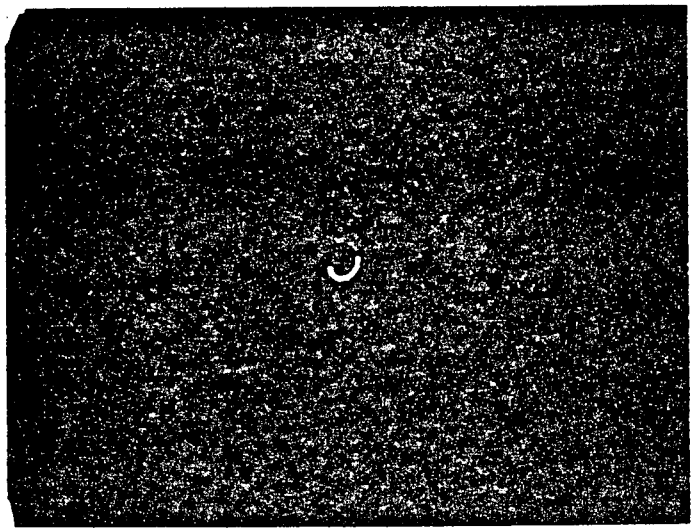
ITT DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

ACCEPTANCE
TEST DATA SHEET

C-Band Translator Down-Converter

INPUT IMEPANCE AND VSWR

3.1



P=1 (FULL SCALE)

SWEEP, 3.95 TO 4.05GHz

Z_0 = 50Ω

3.2 Output Signal Characteristics

Level into 4 GHz Input Circuit	70 MHz Output Level
+40 dBm	-5.8 dBm
+40 dBm	-24.8 dBm (ATTEN SET AT 19dB)
+40 dBm	-74.8 dBm (ATTEN SET AT 69dB)
+20 dBm	-25.8 dBm (ATTEN SET AT 0dB)
+20 dBm	-75.8 dBm (ATTEN SET AT 50dB)

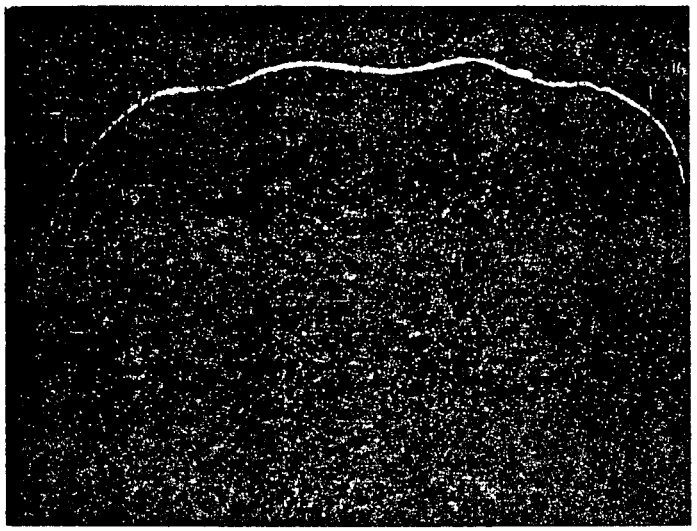
PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.
CHECKED BY	A	28528	1165304
	REV. —		SHEET 6 of 7

ACCEPTANCE
TEST DATA SHEET

C-Band Translator, Down-Converter

SWEPT BANDWIDTH

3.3



VERT CALIB, AS SHOWN
FILED, 3.95 TO 4.05 GHz

INPUT LEVEL INTO
4 GHz PANEL CONNECTOR
+40 dBm
(ACTUAL LEVEL INTO LNA)
-80 dBm

3.4 Receiver Noise Figure

Measured noise figure in dB = 8.3

ADDITIONAL DATA

3.5 Monitor Meter Readings

	Meter Reading
RCVR L-Band Lo	105
+20VDC #1	140
+15VDC #2	110
XMTR L-Band Lo	135

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.
	A	28528	1165304
CHECKED BY		REV. —	SHEET 7 of 7

SPACECRAFT COMMUNICATIONS TERMINAL BREADBOARD COMPONENTS

TEST PROCEDURE DOCUMENT

for the

NASA

Manned Space Flight Center

Houston, Texas

Contract NAS9-12984

ADVANCED DEVELOPMENT

DEFENSE COMMUNICATIONS

492 River Road, Nutley, New Jersey 07110

SEPTEMBER 1972

1. INTRODUCTION

The following report describes the tests to be performed on the C-Band Translator/Transmitter/Attenuator and Translator/Receiver/Attenuator to demonstrate compliance with the End Item Specification contained in Exhibit "A" of contract NAS9-12984 for Spacecraft Communications Terminal Breadboard Components.

2. C-BAND TRANSLATOR/TRANSMITTER/ATTENUATOR TEST DESCRIPTIONS

2.1 INPUT IMPEDANCE AND VSWR

The input impedance and VSWR of the translator receiver will be measured using a network analyzer to display return loss versus frequency for the 20 to 120 MHz input bandwidth as shown in the test setup in figure 2-1. To meet the 1.5:1 VSWR specified, a 14 dB return loss is the minimum allowable.

2.2 OUTPUT SIGNAL CHARACTERISTICS

The output signal characteristics over the specified input range will be measured using the test setup shown in figure 2-2. A 70 MHz, 0 dBm input signal will be applied to the translator and the 6 GHz signal output level will be varied over the specified -110 to -70 dBm range.

A spectrum analyzer will be used to measure the level of the output signal. The input level will then be increased to +10 dBm and the measurement repeated.

2.3 BANDWIDTH

The bandwidth will be measured by sweeping the input frequency range of 20 to 120 MHz with an input level within the 0 to +10 dBm operating range and detecting the 6 GHz output signal using the test setup shown in figure 2-3. The detected output will be displayed on a calibrated oscilloscope and a photo of the amplitude response will be taken. The output will be detected at the up-converter output before the attenuators to provide a -30 dBm minimum level to the crystal detector. Lower detector input levels will not be easily displayed on an oscilloscope. No contribution to amplitude flatness variations is expected from the attenuators since the RF bandwidth is very narrow. The oscilloscope will be calibrated using a precision attenuator and the detector at the same level to be encountered during the test.

2.4 FREQUENCY STABILITY

The frequency stability of the translator will be measured using the test set-up shown in figure 2-4. A crystal oscillator in the input signal range (20 to 120 MHz) will be used as a reference. The frequency of the crystal reference will be counted and recorded. The SHF output frequency will be counted and recorded with a digital recorder.

2.5 SPURIOUS OUTPUTS

The spurious outputs of the translator transmitter will be measured using the test set-up shown in figure 2-5. A 70 MHz signal at a 0 dBm input (worst case) will be applied to the translator and the output displayed on a spectrum analyzer. The up-converter output will be measured before the attenuators since it is not possible to measure -138 dBm with the Spectrum analyzer. The -138 dBm spurious requirement corresponds to a 68 dB carrier-to-spurious ratio at the -70 dBm maximum output level. The up-converter output will be approx -30 dBm before the attenuators. The 68 dB C/S specification translated to this location corresponds to a -95 dBm output level which can be measured.

3. C-BAND TRANSLATOR/RECEIVER/ATTENUATOR TEST DESCRIPTIONS

3.1 INPUT IMPEDANCE AND VSWR

The SHF input impedance and VSWR will be measured using a network analyzer to display the input reflection coefficient versus frequency for the 3.950 to 4.050 GHz input bandwidth as shown in the test set-up of figure 3-1. To meet the 1.5:1 VSWR specified a reflection coefficient of $\leq$ 0.2 is required over the 100 MHz bandwidth.

3.2 OUTPUT SIGNAL CHARACTERISTICS

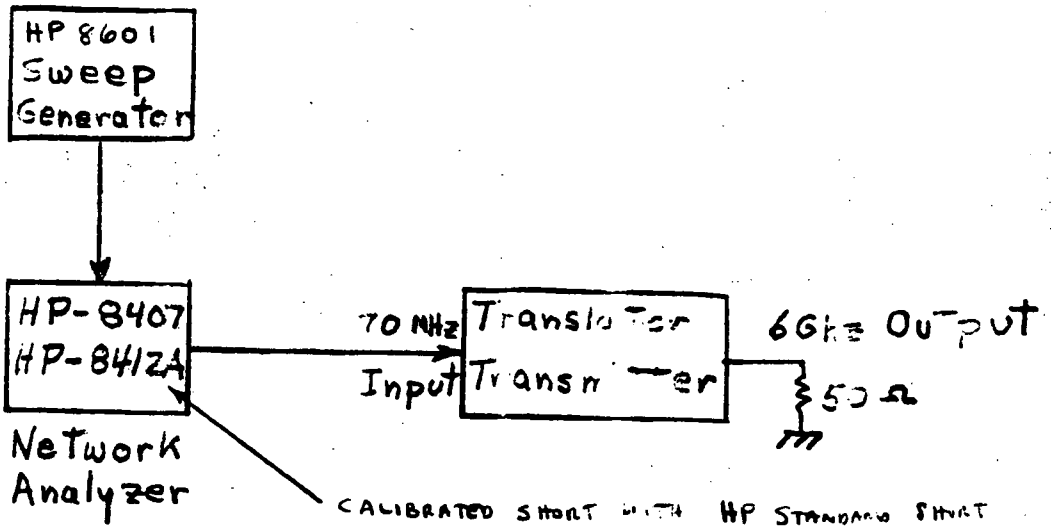
The output signal characteristics of the translator receiver will be measured using the test set-up shown in figure 3-2. The 4 GHz input level will be set at +40 dBm and the 70 MHz output level will be varied over the specified -25 to -75 dBm range. The 70 MHz output level will be measured on a spectrum analyzer. The 4 GHz input will then be adjusted to +20 dBm and the above procedure repeated.

3.3 BANDWIDTH

The translator receiver bandwidth will be measured using the test set-up shown in figure 3-3. The receiver input will be swept from 3950 to 4050 MHz at a level within the +20 to +40 dBm input range. The 70 MHz output will be detected and displayed on a calibrated oscilloscope. A photo of the display will be taken.

3.4 RECEIVER NOISE FIGURE

The receiver noise figure will be measured at the input to the LNA (Low Noise Amplifier) as shown in the test set-up of figure 3-4. The noise figure measurement is automatic with the set-up shown. The 10 dB attenuator is included to improve the accuracy of the measurement by using a more accurate meter range on the noise figure meter.



NOTE: 20, 30, 40, 50, 60, 70, 80, 90, 100 AND 110 MHz MEASUREMENTS MADE WITH ABLE NETWORK ANALYZER.

120 MHz MEASUREMENT MADE WITH "NARDA" MODEL 4001B-20, 60-120 MHz COUPLER

FIG 2-1 Input Impedance 2:1 VSWR

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.
W Shamay 9-25 72	A	28528	A1165313
CHECKED BY			

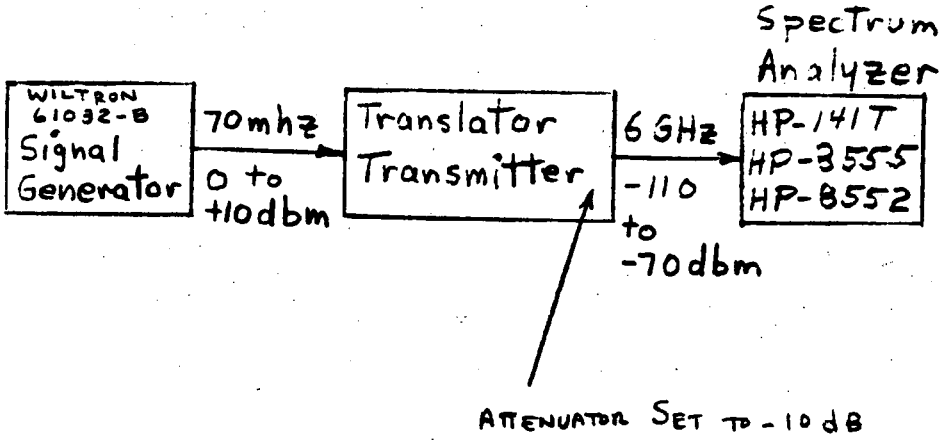


FIG 2-2 Output Signal Characteristics

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.	
W. Shamey 9-25-72	A	28528	A1165313	28
CHECKED BY			REV. A	SHEET 7

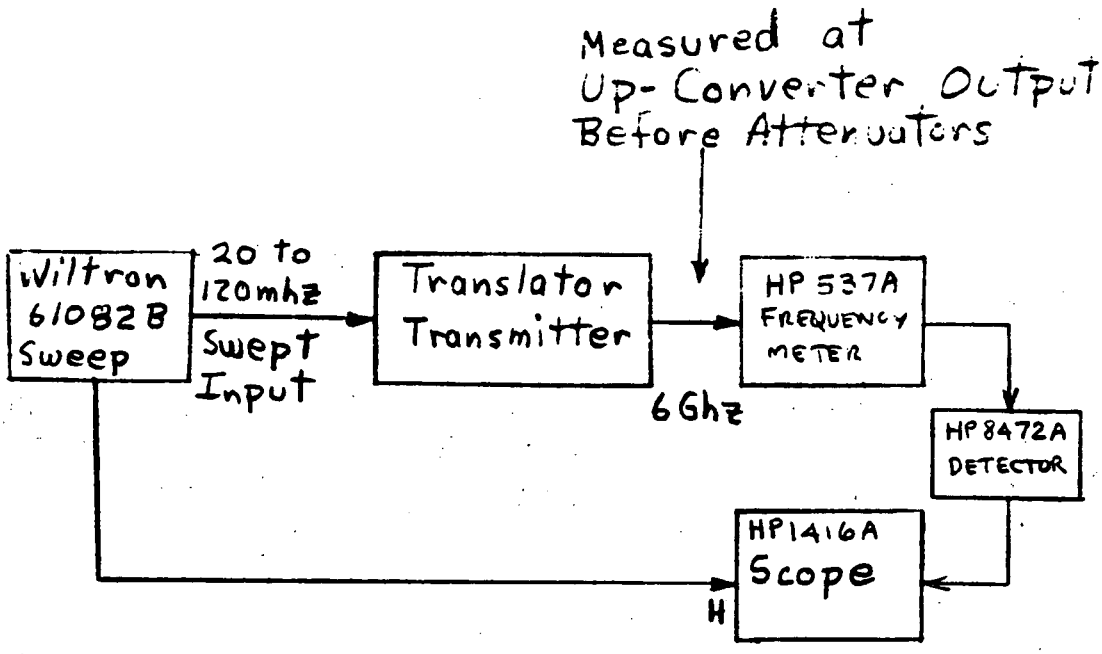


FIG 2-3 Bandwidth

	PREPARED BY W. Shamey 9-25-72	SIZE A	CODE IDENT NO. 28528	DWG. NO. A1165313	29
	CHECKED BY			REV. A	SHEET 8

DRAWING NUMBER

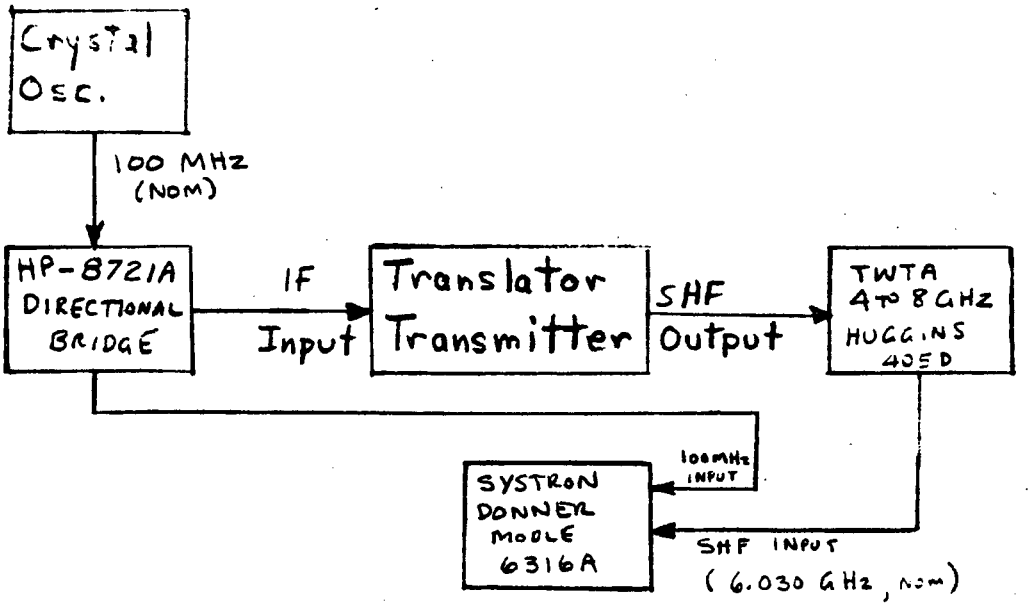


FIG 2-4 Frequency Stability

ITT DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

PREPARED BY W. Shamey 9-25-72
CHECKED BY

SIZE A | CODE IDENT NO. 28528 | DWG. NO. A1165313 | 30

REV. A | SHEET 9

DRAWING NUMBER

ITT DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

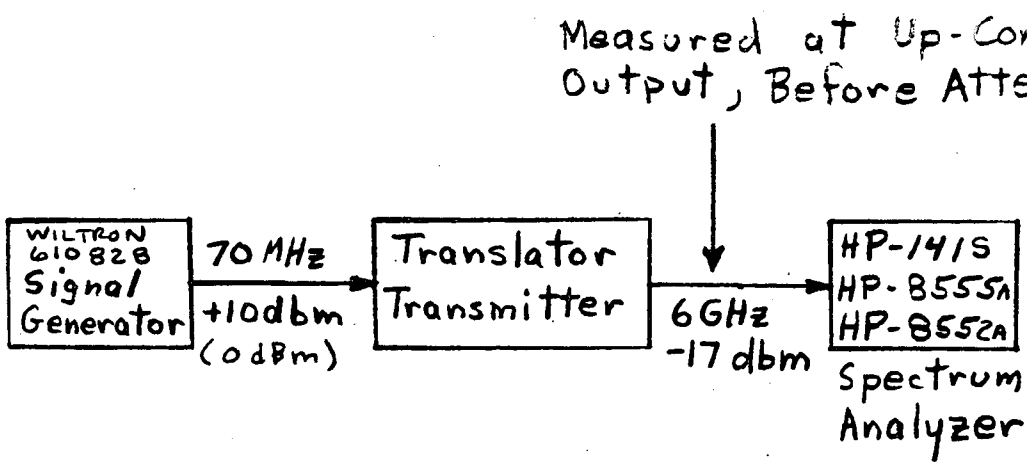


FIG 2-5 Spurious Outputs

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.	
W. Shamey 9-25-72	A	28528	A1165313	31
CHECKED BY			REV. A	SHEET 10

DRAWING NUMBER

ITT DEFENSE COMMUNICATIONS DIVISION
NUTLEY, NEW JERSEY

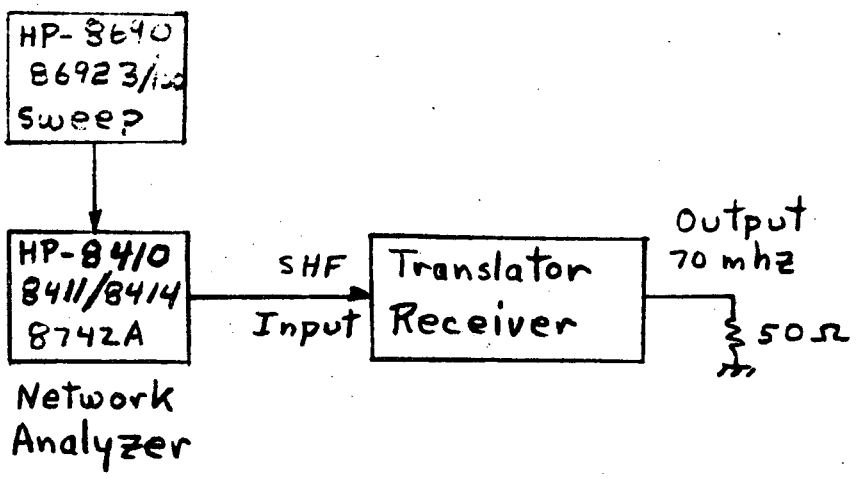
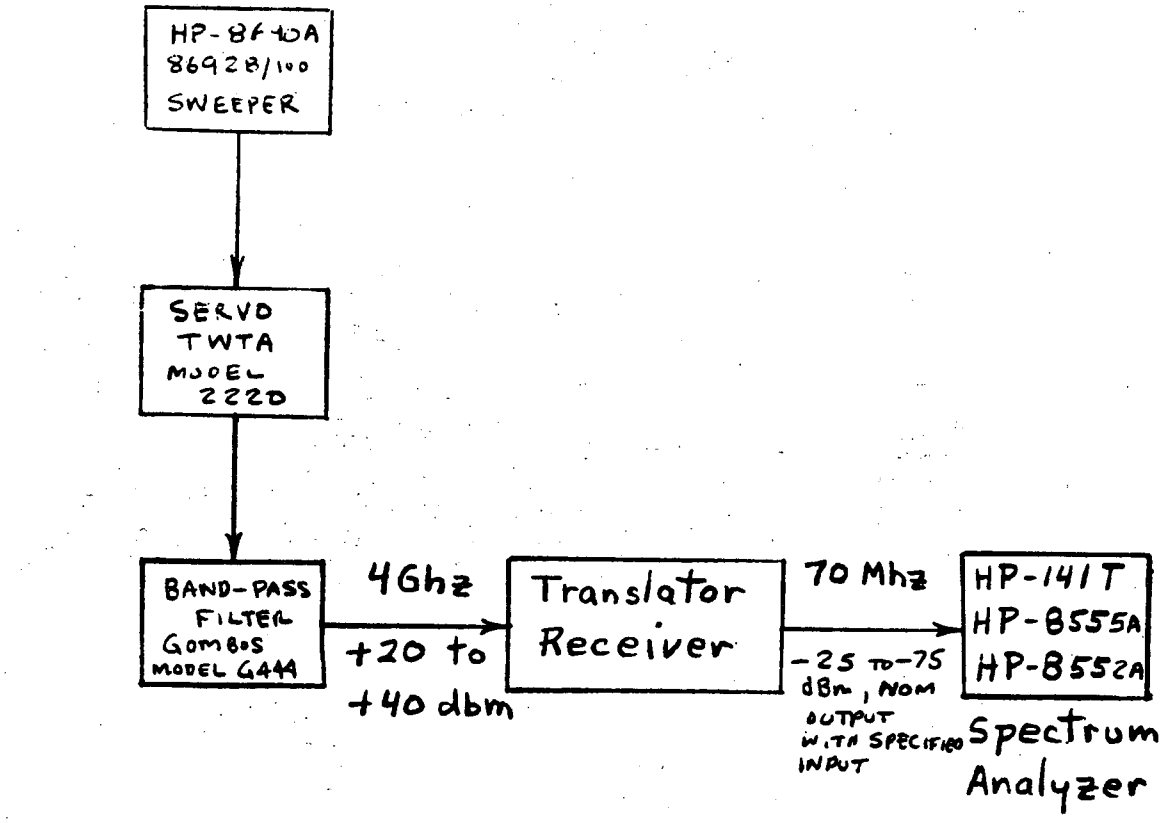


FIG 3-1 Input Impedance and VSWR

	PREPARED BY W. Shamey 9-25-46	SIZE A	CODE IDENT NO. 28528	DWG. NO. A 1165313 32
	CHECKED BY		REV.	SHEET 11



+20 AND +40 dBm POWER MEASUREMENT

PERFORMED AS BELOW

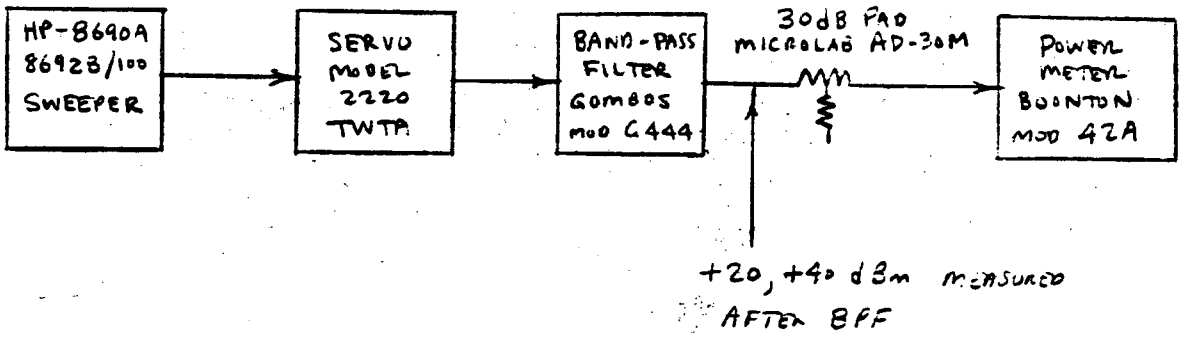
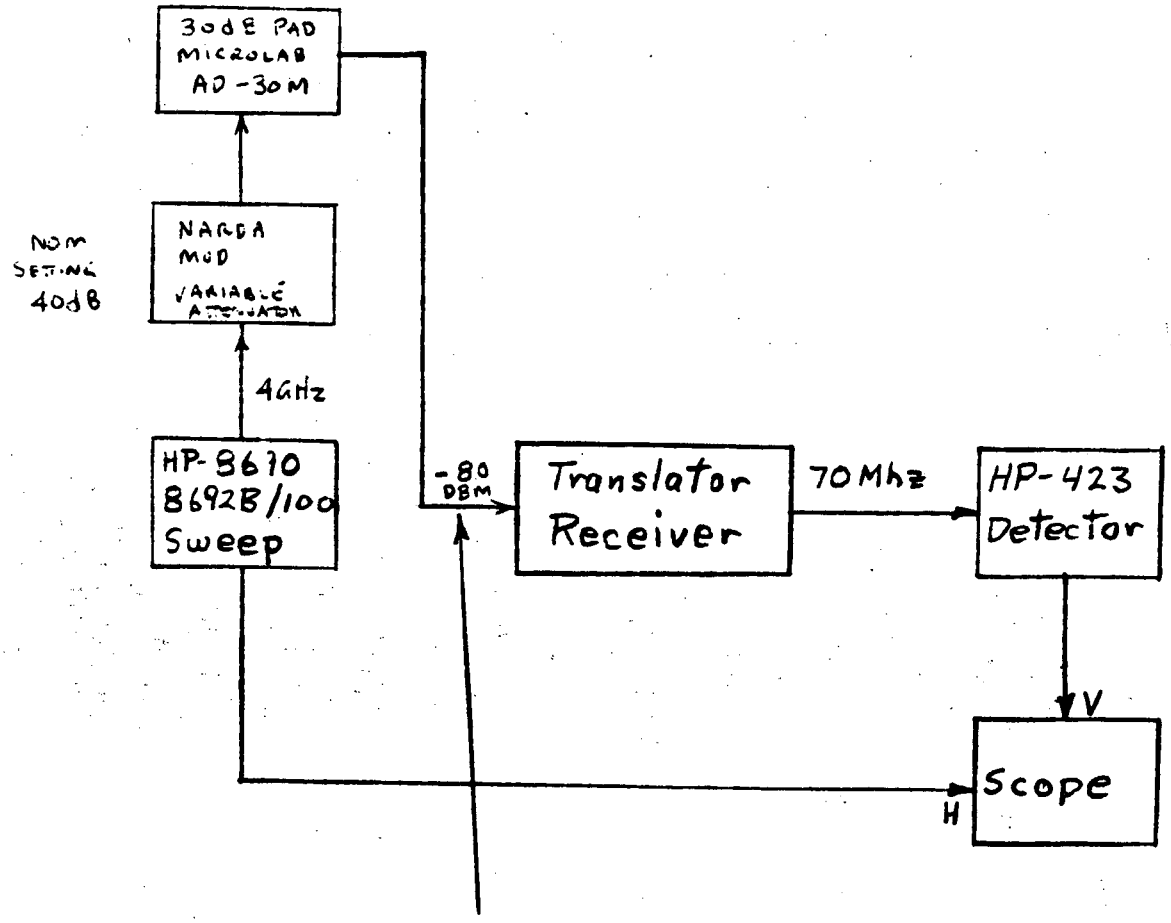


FIG 3-2 Output Signal Characteristics

PREPARED BY	SIZE	CODE IDENT NO.	DWG. NO.	
W. Shamey 9-26-72	A	28528	A1165313	33
CHECKED BY			REV. A	SHEET 12



-80 dBm LEVEL APPLIED DIRECTLY TO LNA INPUT; INPUT DIRECTIONAL, 30 dB AND 60dB PADS BY-PASSED FOR THIS TEST

FIG 3-3 Bandwidth

PREPARED BY: W. Shamey 9-26-72	SIZE: A	CODE IDENT NO.: 28528	DWG. NO.: A1165313	34
CHECKED BY:			REV. A	SHEET 13

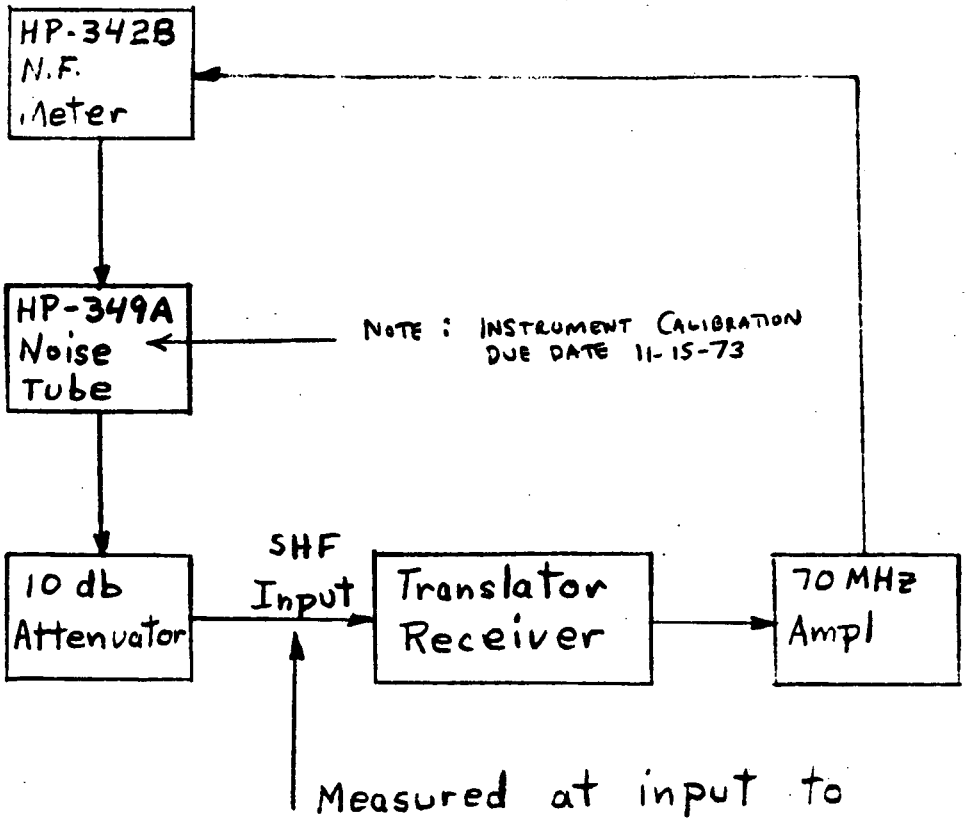
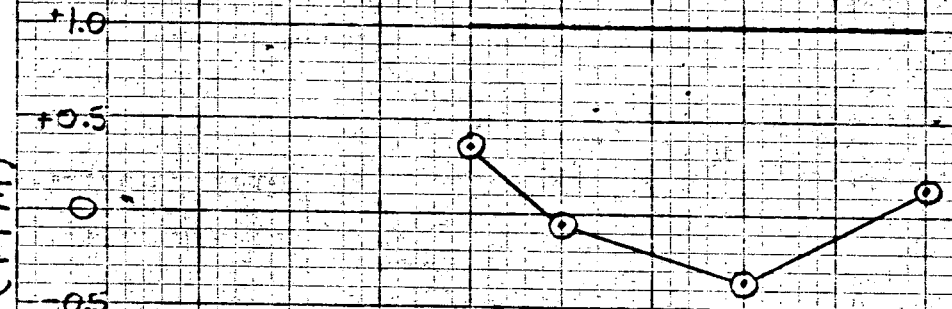


FIG 3-4 Receiver Noise Figure

PREPARED BY W. Shamey 9-26-72	SIZE A	CODE IDENT NO. 28528	DWG. NO. A1165313	35
CHECKED BY			REV. A	SHEET 14 (last)

C.T.S. Knights Inc.
Sandwich, Ill.
TCXO
P/N 970-3233
Freq. 43.796296MHz
S/N 7712-000



$\Delta f/f_{min}$ (PPM)

0 10 15 25 35 45

Temperature (°C)

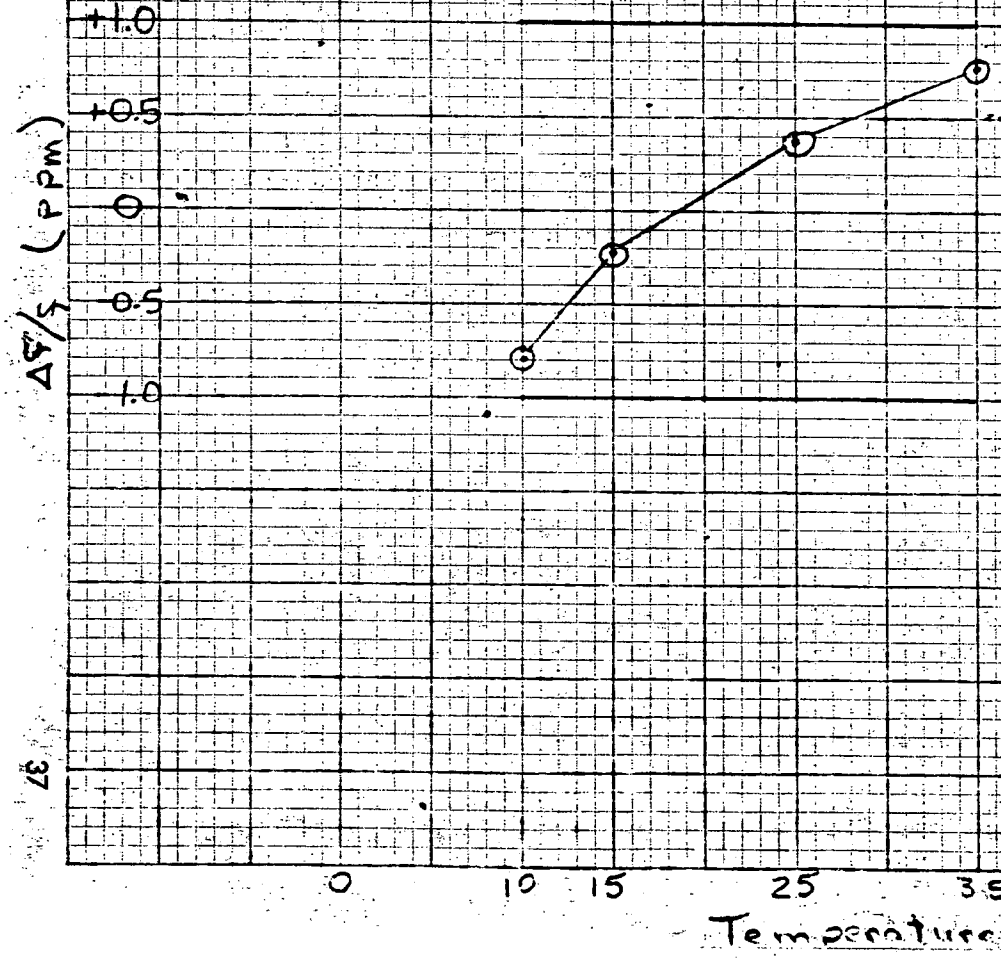
Supply Current ≤ 15mA

Output Power = 1.4mW (into 50Ω)

Harmonics & Sub. Harmonics >30db down

K.R.D.
11/14/72

C.T.S. Knights, Inc.
Sandwich, Ill.
TCXO
P/N 970-3232
Freq. 38.6111 mHz
S/N 7712-0002



Supply Current < 15mA

Output Power = 1.3mW (into 50Ω)

Harmonics & Subharmonics > 30 db down

K. R. 8.
11/14/72

37

Weinschel Engineering

GAITHERSBURG, MARYLAND

TEST REPORT

Type AD 9010-60-11-0
S/N 1329

Job No. 545562

Date: 4/1/73

Customer: Stf

LOT NO.	SERIAL NUMBER do.	FREQ. D.C. ATT. DB	V. S. W. R. MALE	V. S. W. R. FEMALE	FREQ. 4.0 ATT. DB	V. S. W. R. MALE	V. S. W. R. FEMALE	FREQ. 8.0 ATT. DB	V. S. W. R. MALE	V. S. W. R. FEMALE	FREQ. ATT. DB	V. S. W. R. MALE	V. S. W. R. FEMALE
1	0	0			.1			.2					
2	10	9.92			10.0			10.3					
3	20	20.02			20.10			20.2					
4	30	29.94			30.0			30.3					
5	40	39.91			39.9			40.3					
6	50	49.92			49.9			50.4					
7	60	59.86			59.8			59.0					
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													

TESTER B Murphy

QUALITY CONTROL W.J. Simmons

5 MECHANICAL ASSEMBLY

The mechanical details of the Test Translator Assembly can be obtained from the photographs, Figures 1-1, 1-2, and 1-3. Figure 5-1 is a d-c wiring diagram; Figure 1-4 is the r-f wiring diagram

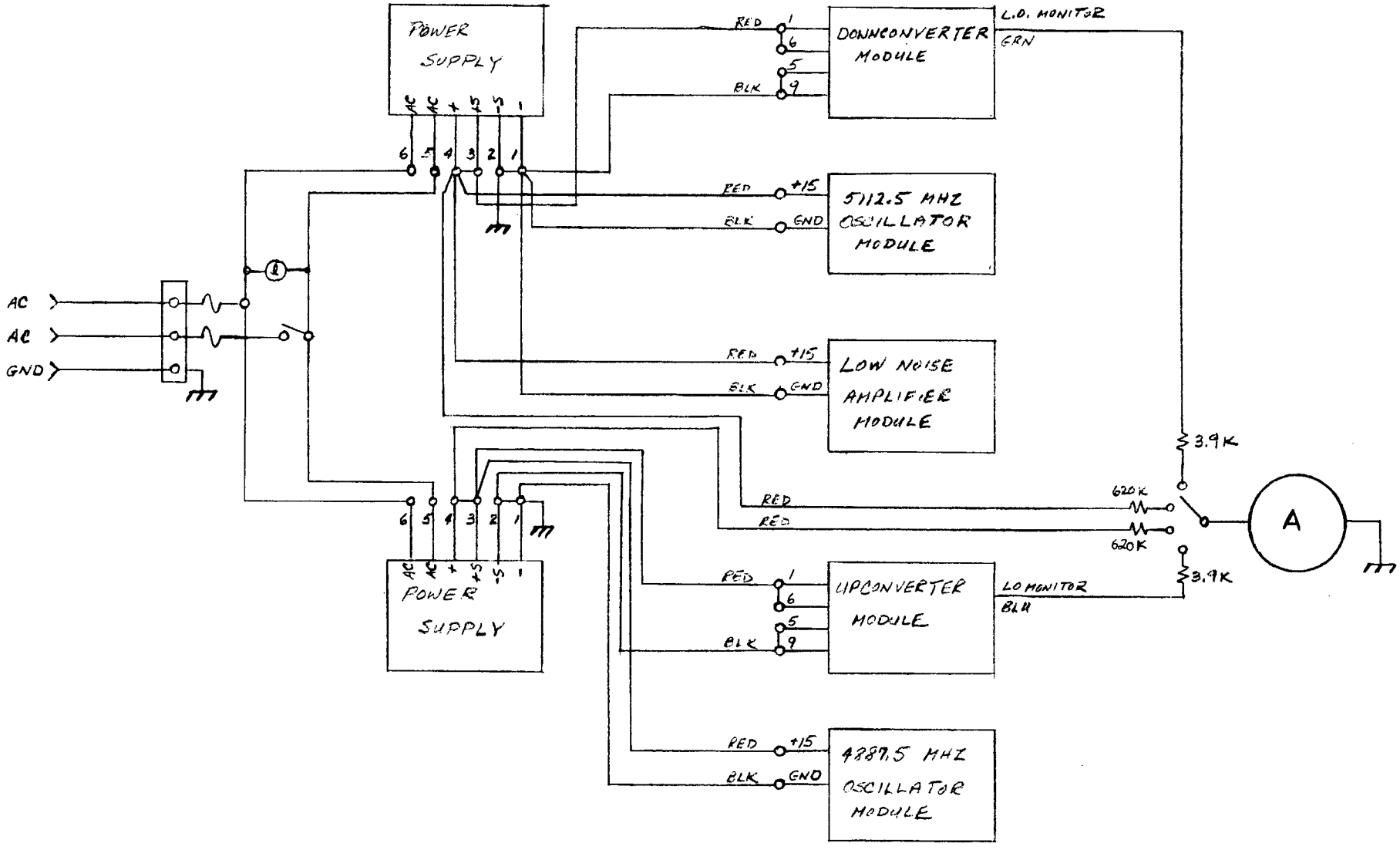


Figure 5-1 Test Translator, D-C Wiring Diagram

6. ENGINEERING PARTS LIST

The pages following are the Engineering Parts List for the CTB Translator.

PARTS LIST

ITT DEFENSE COMMUNICATIONS DIVISION — NUTLEY, NEW JERSEY

CONTRACT NO. | DWG SIZE: A | CODE: 28528 | DRAWING NUMB: PL | REV LTR | SHT

SEE COVER SHEET FOR LIST TITLE, REVISION AND AUTHENTICATION

QUANTITY PER GROUP G5	G4	G3	G2	G1	U OF M	ITEM OR FIND NO.	CODE IDENT	SIZE	PART OR IDENTIFYING NO. OTHER THAN ITTDCD	SIZE	SPECIFICATION NO. / ITTDCD PART NO.	NOMENCLATURE OR DESCRIPTION	ITTDCD SOURCE
				2					POWER MATE UNI-76			POWER SUPPLY	
				1					FREQUENCY SOURCES SN8002			9887.5 MHZ OSCILLATOR	
				1					FREQUENCY SOURCES			5112.5 MHZ OSCILLATOR	
				1					CTS KNIGHT 970-3233-0			TEMP. COMP. XTAL OSCILLATOR 49.79296 MHZ.	
				1					CTS KNIGHT 970-3232-0			TEMP. COMP. XTAL OSCILLATOR 39.6111 MHZ.	
				1					TEXSCAN RA-50			1db STEP ATTENUATOR	
				1					TEXSCAN RA-51			10db STEP ATTENUATOR	
				1					WEINSCHEL 9009			1db STEP ATTENUATOR	
				1					WEINSCHEL 9010			10db STEP ATTENUATOR	
				1					NARDA 4798			VARIABLE ATTENUATOR	
				1					NARDA M374			POWER LOAD	
				2					NARDA 777C-30			30db FIXED ATTENUATOR	
				1					NARDA 777C-60			60db FIXED ATTENUATOR	
				1					NARDA 3043B-30			30db DIRECTIONAL COUPLER	
				1							( )	FILTER, BANDPASS	
				1							( )	AMPLIFIER, LOW NOISE	
	41			1							( )	UPCONVERTER	
				1							( )	DOWNCONVERTER	

U OF M CODE | 1 PIECE 6 PAIR 32 FEET 52 U.S. FLUID OZ. 55 U.S. GAL. | 5 SET 20 REF DOC 54 U.S. LIQUID QT. 68 LB AVDP

* IN PART NO. COL. DENOTES VENDOR ITEM: SEE SOURCE OR SPECIFICATION CONTROL DWG.

PARTS LIST

ITT DEFENSE COMMUNICATIONS DIVISION — NUTLEY, NEW JERSEY

CONTRACT NO. | DWG A SIZE | CODE 28528 | DRAWING NUMB PL | REV LTR | SHT

SEE COVER SHEET FOR LIST TITLE, REVISION AND AUTHENTICATION

QUANTITY PER GROUP G5	G4	G3	G2	G1	U OF M	ITEM OR FIND NO.	CODE IDENT	SIZE	PART OR IDENTIFYING NO. OTHER THAN ITTDCD	SIZE	SPECIFICATION NO. / ITTDCD PART NO.	NOMENCLATURE OR DESCRIPTION	ITTDCD SOURCE
				1					WESTON MODEL 2521			MICROAMMETER	
				1								FILTER 4887.5 MHZ	
				1								FILTER 5112.5 MHZ	
				2								FUSE 3A, 120V	
				2								FUSE HOLDER	
				1								INDICATING LAMP	
				1								LAMP HOLDER	
				1								SWITCH ON-OFF	
				1								SWITCH 4 POLE SINGLE THROW	
	42												

U OF M CODE | 1 PIECE 5 SET | 6 PAIR 20 REF DOC | 32 FEET | 52 U.S. FLUID OZ. 54 U.S. LIQUID QT. | 55 U.S. GAL. 68 LB AVDP

* IN PART NO. COL. DENOTES VENDOR ITEM: SEE SOURCE OR SPECIFICATION CONTROL DWG.